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SOIL SURVEY
OF
WARREN COUNTY, IOWA

BY

A. M. O'NEAL, Iowa Agricultural Experiment Station, in Charge,
and R. E. DEVEREUX, U. S. Department of Agriculture

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COUNTY SURVEYED

Warren County is in the south-central part of Iowa, in the third tier of counties north of the Missouri State line. The northern boundary is 6 miles south of Des Moines. The county is square, measuring 24 miles in each direction. It contains 16 full townships, and has an area of 570 square miles or 364,800 acres.

Physiographically the county consists of a loess-covered drift plain that varies from undulating to strongly rolling. The greater part of the northern half is undulating or gently rolling. Here the hills are evenly rounded and the slopes are gentle and little furrowed by erosion, as in other parts of the county. The valley floors of the rivers and creeks are predominantly wider and the escarpments are less precipitous. South and east of a line drawn through Lida, Spring Hill, Indianola, Ackworth, and Hartford the relief is more pronounced. The interstream divides are less extensive than in the northern part of the county and they have a smoother surface and terminate rather abruptly on joining the rough eroded areas which border all the streams and drainage ways. Two exceptions to this general rule occur in the vicinity of Milo and Liberty Center, where level or gently undulating areas are extensive. Along the southeastern slopes of Middle River and South River the bluffs are more abrupt and the hills are higher than to the north and northwest where the bordering uplands have a gentler, less serrated appearance.

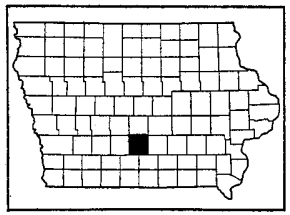


FIGURE 1.—Sketch map showing location of Warren County, Iowa

The alluvial deposits which occur along the rivers and practically all creeks of the area include the older materials which now occupy terrace positions and the more recent deposits that are subject to occasional inundation. The most extensive terraces are along Middle, South, and Des Moines Rivers and small isolated areas

feet;[1] Indianola, just north of the geographical center of the county, 966 feet; Lacona, near the southeast corner, 822 feet; Milo, in the east-central part, 972 feet; and Hartford, in the northeastern part, 880 feet. Carlisle, which is situated partly on the Des Moines River bottoms, has an elevation of 784 feet, and the altitude at the point where Des Moines River flows into Marion County is approximately 755 feet. The prevailing slope of the land is northeastward.

The drainage of the county is carried by Des Moines River, which forms about 6 miles of the extreme northeastern boundary. This stream meanders through a rather wide flood plain that is subject to local overflows. The present level of the valley floor is 70 or 80 feet below that of the bordering uplands. Small creeks and drainage ways ramify all parts of the uplands, except practically level areas in the vicinity of Milo and Liberty Center. Drainage in the flat areas is poor, and tiling is necessary for best farming results. Throughout the undulating or moderately rolling sections drainage is usually sufficient, but even here it has proved advantageous to tile the depressions and swales. The rougher sections adjacent to streams suffer from erosion and should never be left without cover. Practically all the first bottoms are subject to inundation in time of extreme overflow, but since the rivers and many of the creeks have been straightened and ditched this menace has been largely overcome and crops seldom suffer from excess moisture.

Most of the farms of the county are supplied with water obtained from bored wells. In the uplands good water is reached at a depth ranging from 175 to 200 feet, but in the bottom lands most of the wells are much shallower.

According to the 1920 census, the population of Warren County is 18,047. The total urban population is given as 3,628. The rural population is 14,419, an average of 25.3 persons to the square mile.

Indianola, with a population of 3,628, is the county seat and principal town. Simpson College is located here, as are also a produce house, several factories, and a creamery. Carlisle, in the northeastern part of the county, has a population of 640 and is an important tile and brick manufacturing center. Milo, with a population of 560; Lacona, with 502; New Virginia, with 424; Norwalk, with 331; Hartford, with 218; and Martensdale, with 100, are smaller railroad towns. Other towns of local importance are Ackworth, Beech, Ford, Palmyra, Liberty Center, St. Marys, Wick, Conger, Spring Hill, Lida, Cumming, and Orillia.

Warren County was organized in January, 1849. The early settlers came mainly from States to the east and south. Later a number of foreign-born, mostly German and Irish, immigrants moved in and took up lands. At the present time, however, the entire population is made up of native-born Americans.

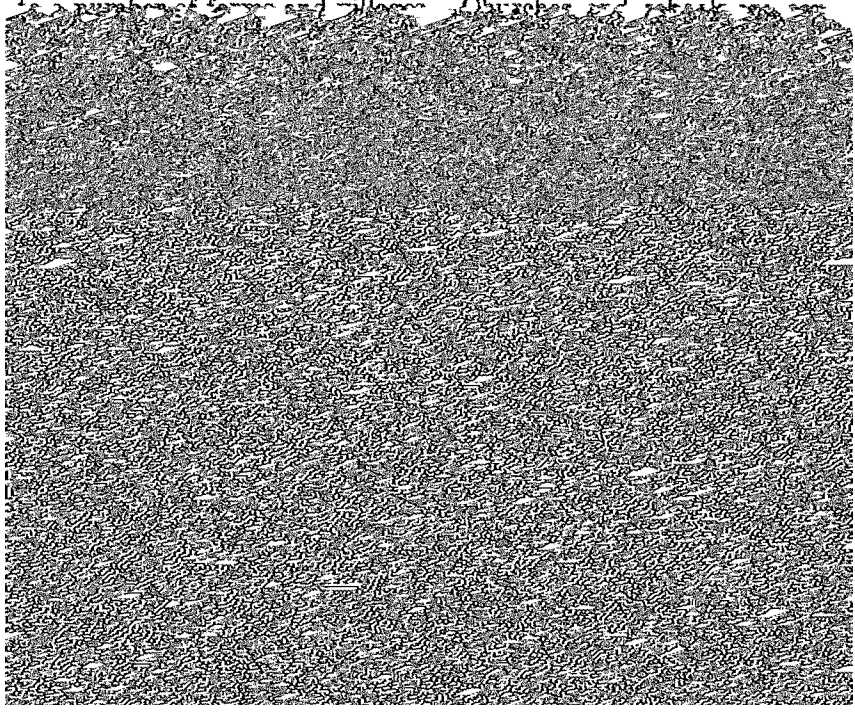
Warren County is served by three railroads, the Great Western, the Chicago, Rock Island & Pacific, and the Chicago, Burlington & Quincy. The main line of the Great Western Railway, which runs from Des Moines to Kansas City, crosses the western part of Linn and Jefferson Townships. A branch of the Chicago, Burlington & Quincy Railroad serves the western half of the county. This road passes through Norwalk, Martensdale, and St. Marys and leaves the

[1] GANNETT, HENRY. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. (FOURTH EDITION.) U. S. Geol. Survey Bul. 274, 1072 p. 1906.

county just south of the center of the western boundary, but again loops back into the extreme southwestern corner and passes through New Virginia. Another branch of this same system runs across the extreme northeastern corner and closely follows the Des Moines River bottoms. Another branch enters the county from the south, passes through Lacona, Milo, and Ackworth, and terminates at Indianola. The Chicago, Rock Island & Pacific Railway enters the county just north of Carlisle where it divides, one branch extending southeastward through Hartford and Beech and the other closely following the bottoms of Middle River. The last-mentioned branch passes through Summerset, Spring Hill, and Martensdale, and a spur line joins Summerset and Indianola. In addition to the railroads, bus lines radiating from Des Moines serve a large number of towns.

Warren County has a complete system of improved dirt roads. These roads either follow land lines or are parallel to them, except in the rougher sections adjacent to the larger streams. Although no hard surfacing has been done, except in short stretches in the vicinity of Carlisle and Norwalk, the principal county roads have been brought to grade. Tiling has also been done where necessary, fences put up along dangerous fills, and permanent culverts and bridges constructed. The transcontinental Jefferson Highway crosses the the county in a north-and-south direction and passes through Indianola. In dry weather the roads are very good, but rains soon cause travel to become slow, difficult, and in many places dangerous. Most of the roads are dragged immediately after rains.

Telephone lines and rural mail routes serve all parts of the county. Electric transmission lines, radiating from Indianola, furnish current



maturing. As a rule, the precipitation is rather low in the fall. This feature is very favorable for harvesting the crops. The year of this survey (1925) was an exception to this rule, when rains continuing from October to the Christmas holidays hampered farming operations. Hailstorms are rare, and the damage caused by them is local.

The precipitation during winter usually occurs as snow, and the average annual snowfall is 27.6 inches. Snow frequently blankets the ground for a long time. This protection prevents winter wheat and alfalfa from freezing.

The average date of the last killing frost is April 25 and of the first is October 8. This gives an average frost-free season of 166 days. The latest recorded killing frost occurred on May 19 and the earliest on September 20. The grazing season continues from about the middle of April to the last of October.

Table 1, compiled from records kept by the United States Weather Bureau station located at Indianola, gives the normal monthly, seasonal, and annual temperature and precipitation.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Indianola*

[Elevation, 972 feet]

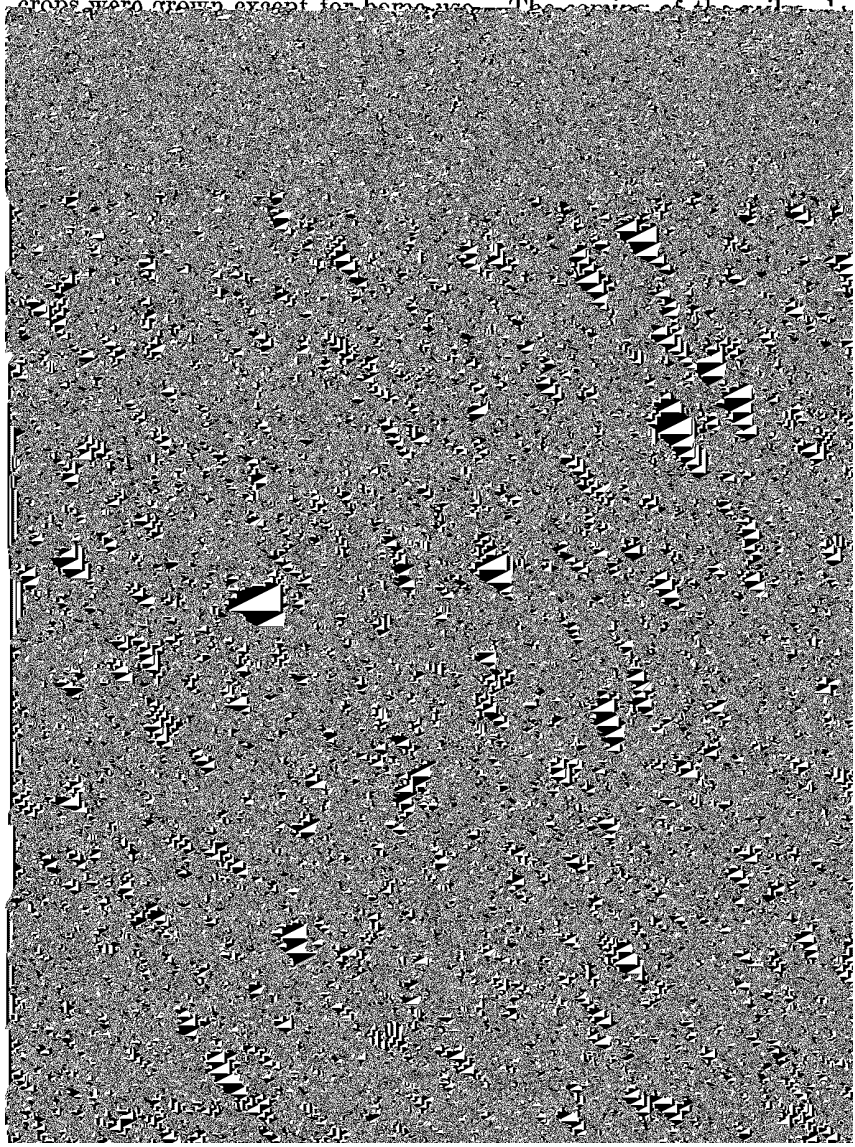
Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1894)	Total amount for the wettest year (1902)	Snow average depth
	° F.	*° F.*	*° F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	26.3	64	−23	1.45	0.90	2.95	6.0
January	20.4	63	−32	1.21	.68	.84	7.2
February	23.1	66	−28	1.19	.77	.72	7.3
Winter	23.3	66	−32	3.85	2.35	4.51	20.5
March	35.6	87	−10	1.56	.99	1.12	4.3
April	50.5	91	14	3.21	1.79	1.61	.9
May	61.6	93	21	4.49	1.43	5.54	Trace.
Spring	49.2	93	−10	9.26	4.21	8.27	5.2
June	70.3	100	41	4.46	1.29	6.50	0
July	75.1	109	48	3.74	.40	7.25	0
August	72.9	111	39	4.28	.95	9.48	0
Summer	72.8	111	39	12.48	2.64	23.23	0
September	65.0	99	23	3.42	4.53	5.45	0
October	52.9	89	15	2.48	1.09	3.25	.2
November	37.1	78	1	1.48	.83	2.59	1.7
Fall	51.7	99	1	7.38	6.45	11.29	1.9
Year	49.2	111	−32	32.97	15.65	47.30	27.6

AGRICULTURE

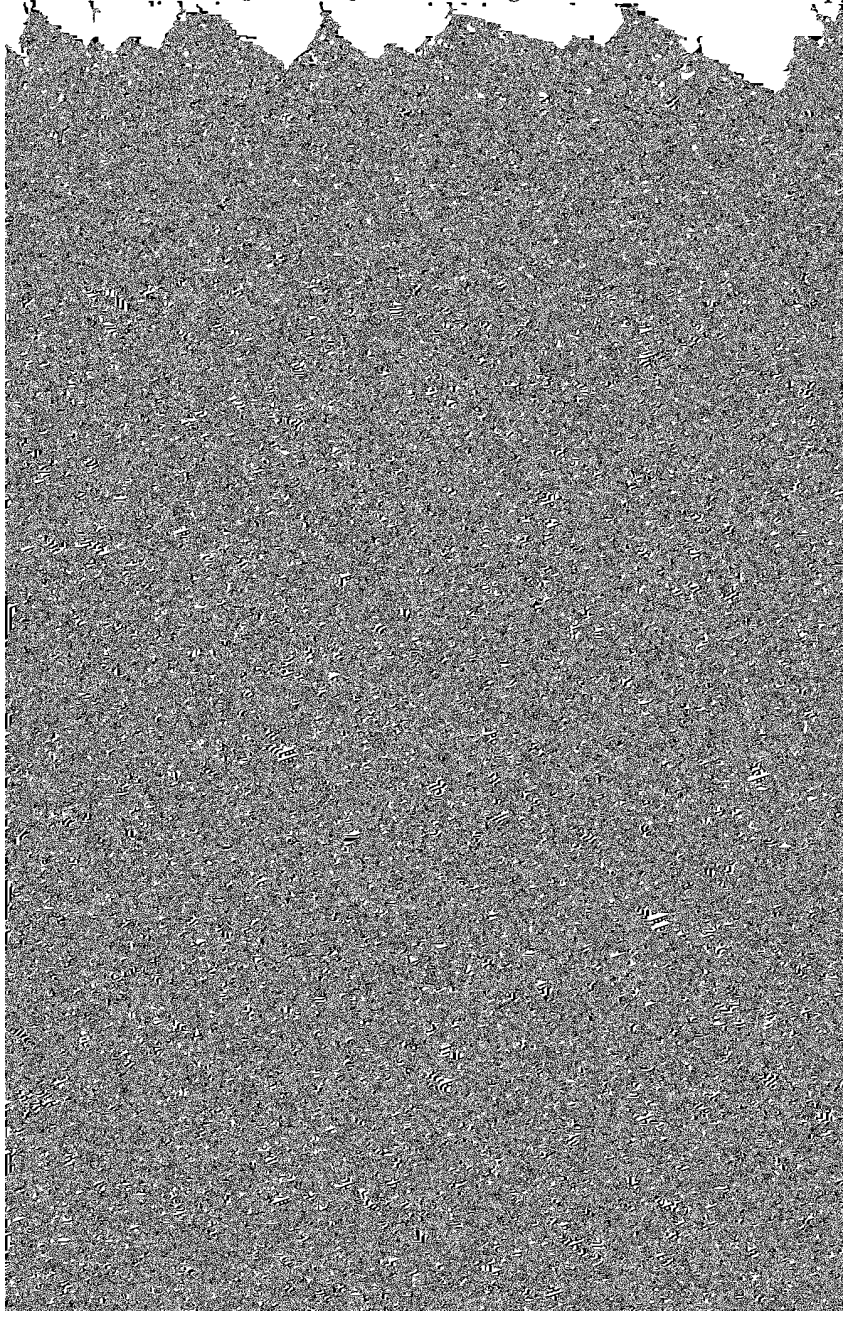
The agricultural development of Warren County began in 1845 when the first claim was taken up just north of the present town of Palmyra. During the next few years the influx of pioneers was slow, and most of them built their homes in the timbered areas adjacent to streams where water was easily accessible and the trees afforded protection from the cold winds of winter. These pioneers spent most

of their time in trapping, as game was plentiful. They cultivated only sufficient land to supply some of the necessities of the home. As the population increased, more land was reclaimed and planted to the staple crops. Corn and wheat were the principal crops, but some oats, barley, and rye also were grown. Some farmers sowed flax for a year or two on freshly broken sod. The luxuriant grass vegetation of the prairies soon lead to an increase in the raising and feeding of cattle.

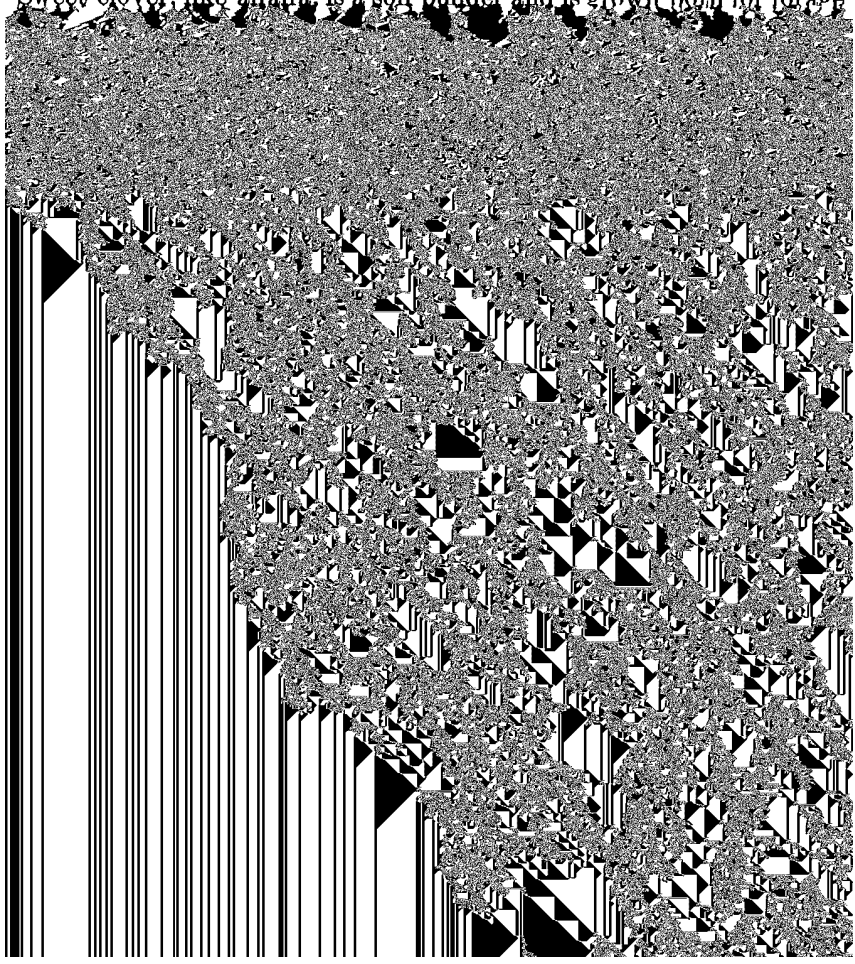
Prior to the building of the railroads the marketing of products was difficult and often impractical. This curtailed production, and no crops were grown except for home use. The coming of the railroads



obtained on the new ground. Lack of proper crop rotations soon impaired these yields, and in 1879, according to the 1880 census, the average production was only 10 bushels to the acre. During the next decade a comparatively small acreage was devoted to this crop,



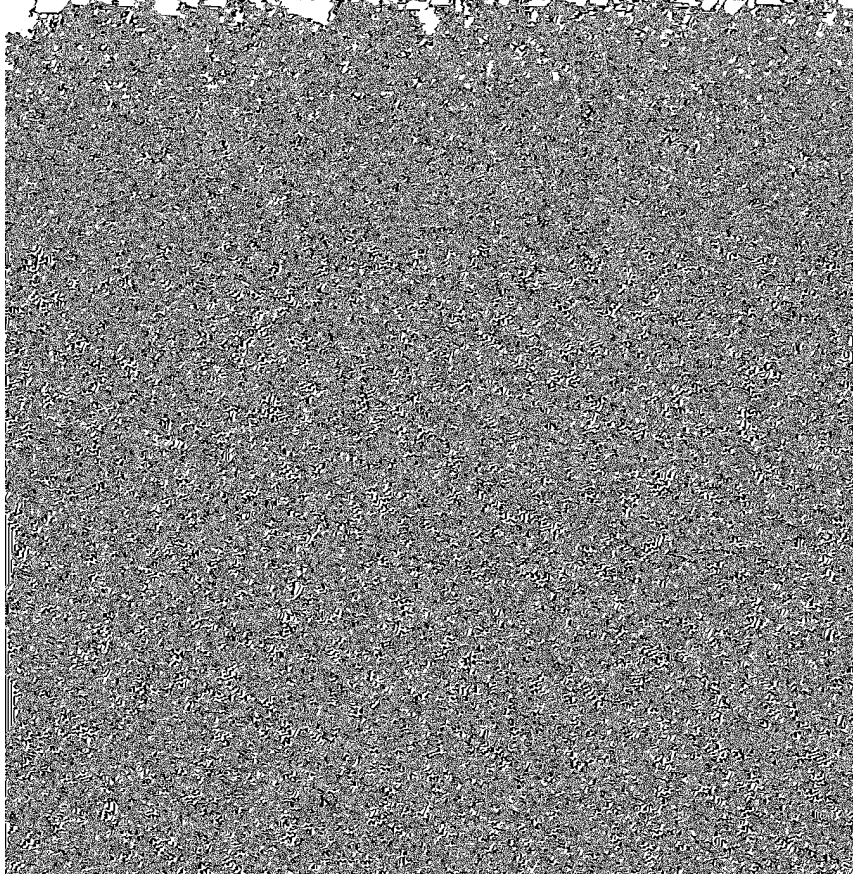
Hay and forage crops rank fourth in importance, though the acreage in 1919 was more than that of oats. The total acreage in tame and cultivated grasses, which amounts to 25,541 acres, is nearly double the combined acreage of wild or prairie grasses, grains cut green, coarse forage, and silage crops. Timothy and clover, grown separately or together, are most important. Because of its soil-improving properties, alfalfa is receiving more attention, and it is estimated that 1,502 acres will be devoted to this crop in 1926. Dakota No. 12 and Grimm are the favorite varieties. In 1919 the average acre yield for hay and forage crops was as follows: Alfalfa, 2.3 tons to the acre; timothy and clover, 1.7 tons; clover alone, 1.2 tons; and timothy, 1.09 tons. Red clover is extensively grown, but alsike and mammoth clover are also popular. Alsike is largely grown on the bottoms, where it gives best results. Sweet clover is increasing in importance. In the fall of 1925 a carload of seed was shipped into the county, and it is estimated that 1,115 acres will be planted to this crop in 1926. Sweet clover, like alfalfa, is a soil builder and is grown both for forage



brood sows. Most of the hogs are of mixed breeds, but an increasing number of farmers are attempting to keep only purebred animals.

The lard-type breeds, of which the Duroc-Jersey is the most popular, are preferred. The Poland China, Spotted Poland China, and Chester White follow in numbers in the order named. The Tamworth is the principal bacon breed. About two-thirds of the pigs are farrowed in in the fall and one-third in the spring. In some years cholera causes considerable loss. The 1922 Iowa Year Book reported a total loss of 4,536 pigs from this disease in 1922. It is common custom to fatten the hogs and sell them when they are between 6 and 10 months old, either through cooperative selling associations or in car lots by individual farmers. The principal markets are Chicago and Kansas City.

The raising and feeding of beef cattle ranks next to hog raising in importance. Although a number of animals are raised on the farms of Warren County, the common practice is to ship in feeders in the fall or early winter. The 1922 Iowa Year Book reported a total of 30,679 beef animals on the farms on January 1, 1923, or an average of 17 head to the farm. On many farms the number is much smaller, and in certain parts of the county, particularly the northern half, herds varying from 60 to 100 head are kept. Feeders prefer young

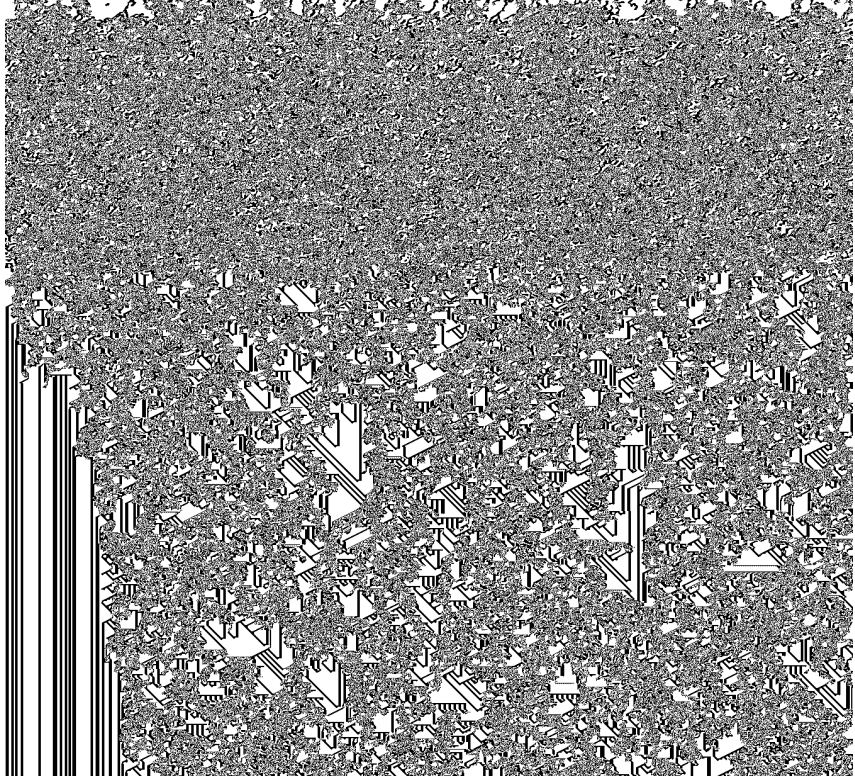


The production of chickens and eggs, although strictly a side line, is important. The United States census of 1920 gives the value of poultry and eggs produced in 1919 as $713,604, and the 1922 Iowa census reports 302,590 chickens in the county on January 1, 1923, and an estimated production of 1,191,181 dozen eggs. The poultry and eggs are sold largely at the produce house in Indianola or to buyers who resell in Des Moines.

On most farms surface relief has had little effect on the production of general farm crops. The rougher farmed areas produce lower yields, owing mainly to erosion which is largely overcome in some places by the use of brush and concrete dams. The straightening and dredging of many of the rivers and creeks has also reclaimed much land that formerly was unfit for profitable agriculture.

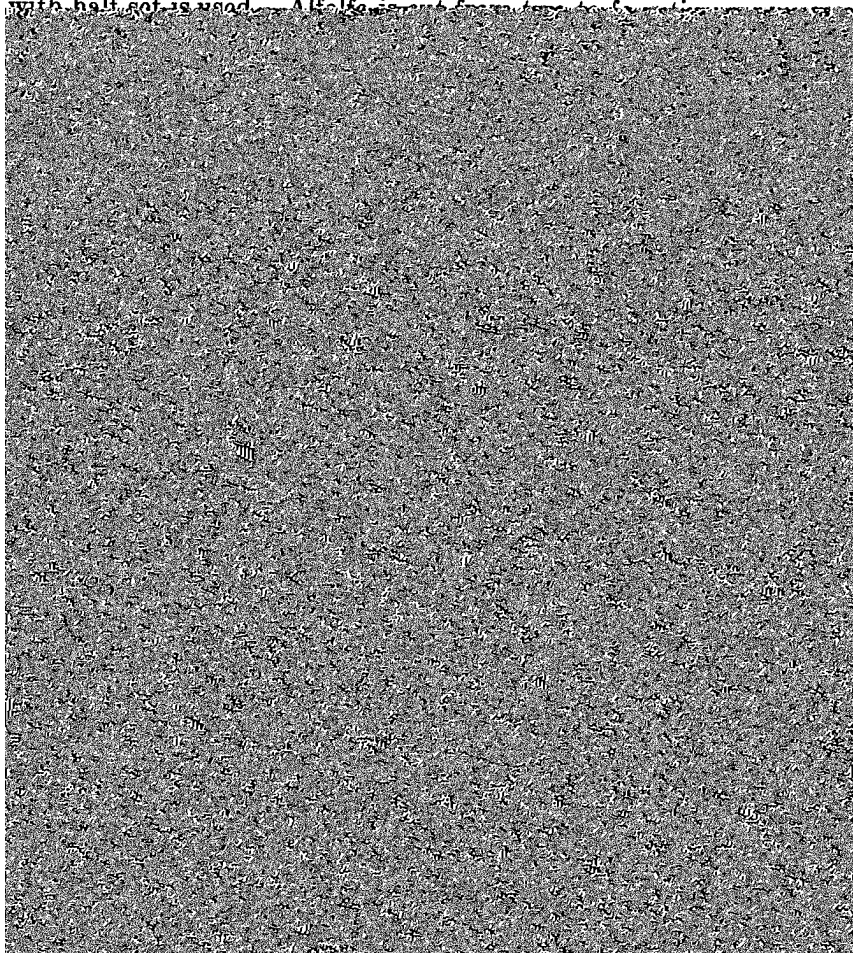
The farmers of Warren County recognize that it is impractical to cultivate the rougher land adjacent to streams, and such areas are left for permanent pasture. Many of the poorly drained first bottoms are also left with their natural cover, as cropping would not be profitable. Except for wheat production the upland soils are not considered inferior to the bottom-land soils. Wheat usually gives best results on the heavier bottom land, where it takes the place of oats in the general rotation. In selecting alfalfa land, due consideration is given to drainage. The sandy areas are used exclusively for the production of melons and truck crops.

Cornland throughout the level or gently rolling parts of the county is usually plowed in the fall and disked and harrowed the following spring. The rougher areas are all plowed in the spring on account of



twice and is then harrowed without plowing. This crop also is largely drilled in. Where clover or clover and timothy are included in the rotation, spring seeding with oats or wheat as a nurse crop is the common practice. Where clover is planted with wheat the seed is either broadcast in the fall and allowed to work into the ground through alternate freezing and thawing or is harrowed in during April. After the grain is harvested the clover and timothy attain sufficient growth to afford light pasturage in the fall. The following year the clover and timothy are either cut for hay or are pastured, after which the stubble land is left by some farmers as a foundation for permanent pasture.

Alfalfa, as a forage crop, is increasing in importance each year. More attention is given than formerly to the selection of seed and the soil on which the crop is grown. Approximately 80 per cent of the alfalfa is planted in the fall without a nurse crop. Spring seedings are always combined with oats or wheat. The rate of seeding is usually 15 pounds to the acre. Practically all fields are limed, and the seed is inoculated. One cultivation a year is usually given the crop, and for this purpose a spring-tooth harrow or disk harrow with half set is used. Alfalfa is cut from two to four times



from $6 to $12 an acre, depending on the condition of improvements and the location of the farm. Other methods, more or less in vogue, consist of the grain and stock share plans. Under the grain-share system the tenant receives one-half the corn and two-thirds the small grain, and he furnishes the seed, work animals, and labor. The landowner always purchases the clover seed and receives half the hay. The stock-share plan differs in that the owner and tenant share equally the cost of feeders and divide all revenues equally.

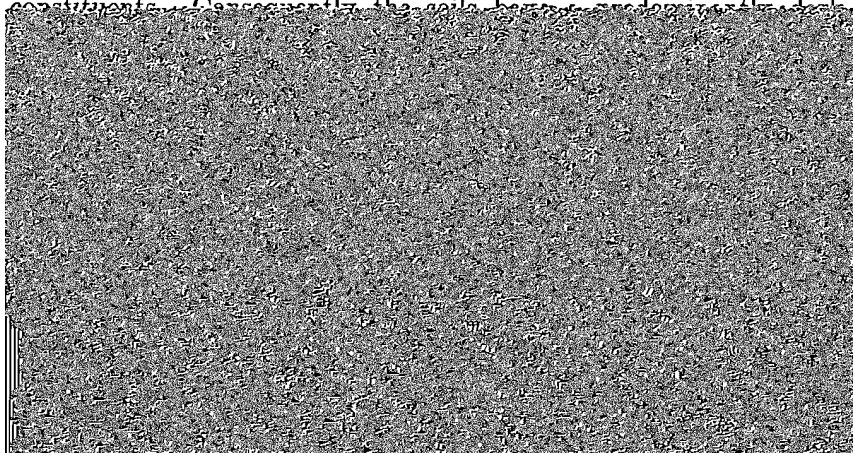
The census of 1920 reports the average size of farms as 140.5 acres, 84.2 per cent of which is improved land. Much larger holdings are found in some parts of the county. Near the towns, farms ranging in size from 40 to 90 acres are more numerous.

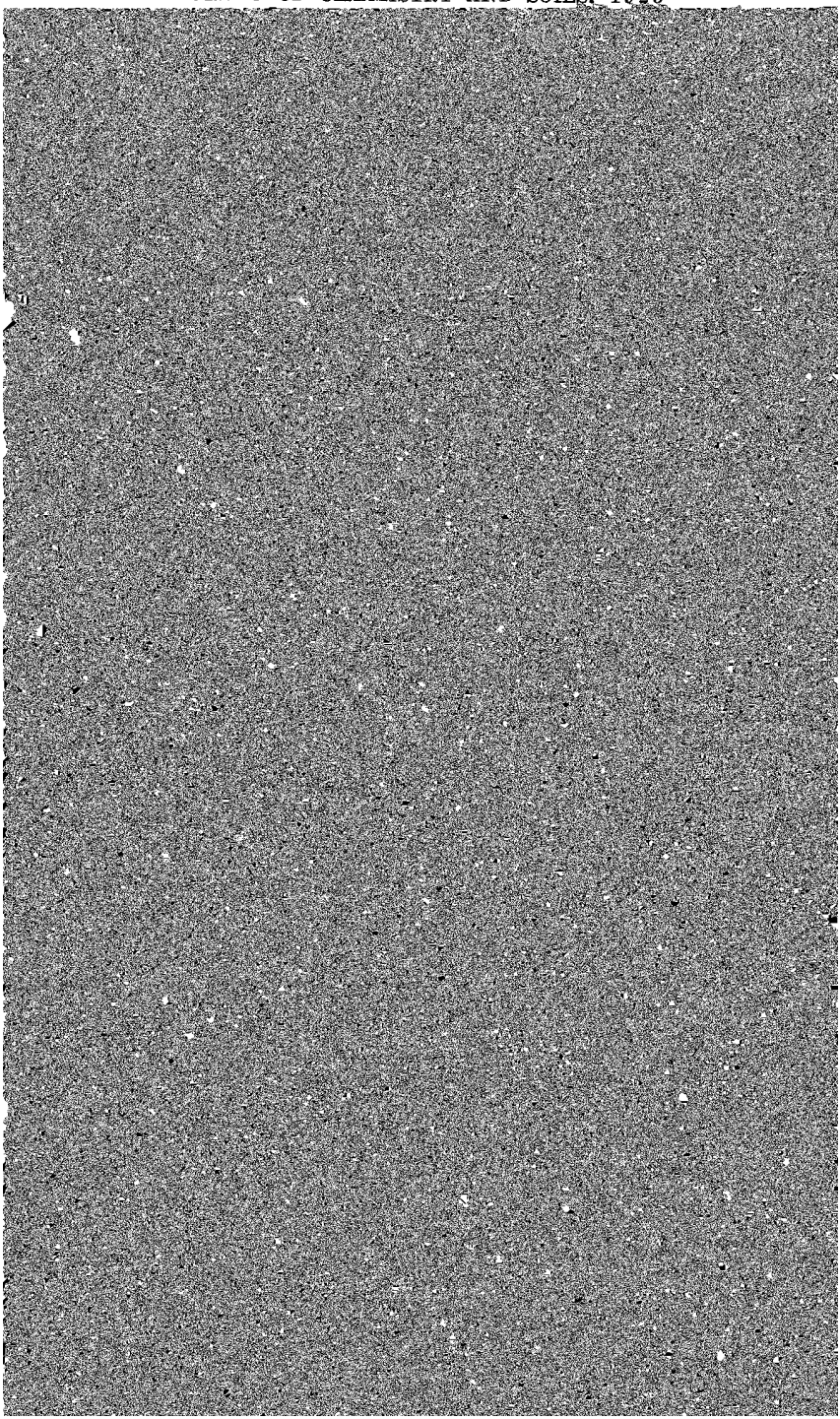
It is hard to obtain definite land values at present because few farms have changed hands within the last year or so. In the vicinity of towns well-drained and improved soils such as Tama silt loam, Grundy silt loam, and Muscatine silt loam range in value from $175 to $225 an acre. The Shelby and Lindley soils, which are predominantly rough and strongly rolling, are valued much lower, commanding from $75 to $125 an acre. The improved well-drained bottom-land soils command from $150 to $200, and the unimproved timbered areas may be bought for about half that amount.

SOILS [2]

The soils of Warren County have developed under prairie conditions, with the exception of a few comparatively small more or less isolated areas where better drainage and more thorough aeration has encouraged forest growth. The native vegetation under which the soils were developed was grass on the level or moderately rolling areas and timber along the rougher belts and adjacent to the larger streams.

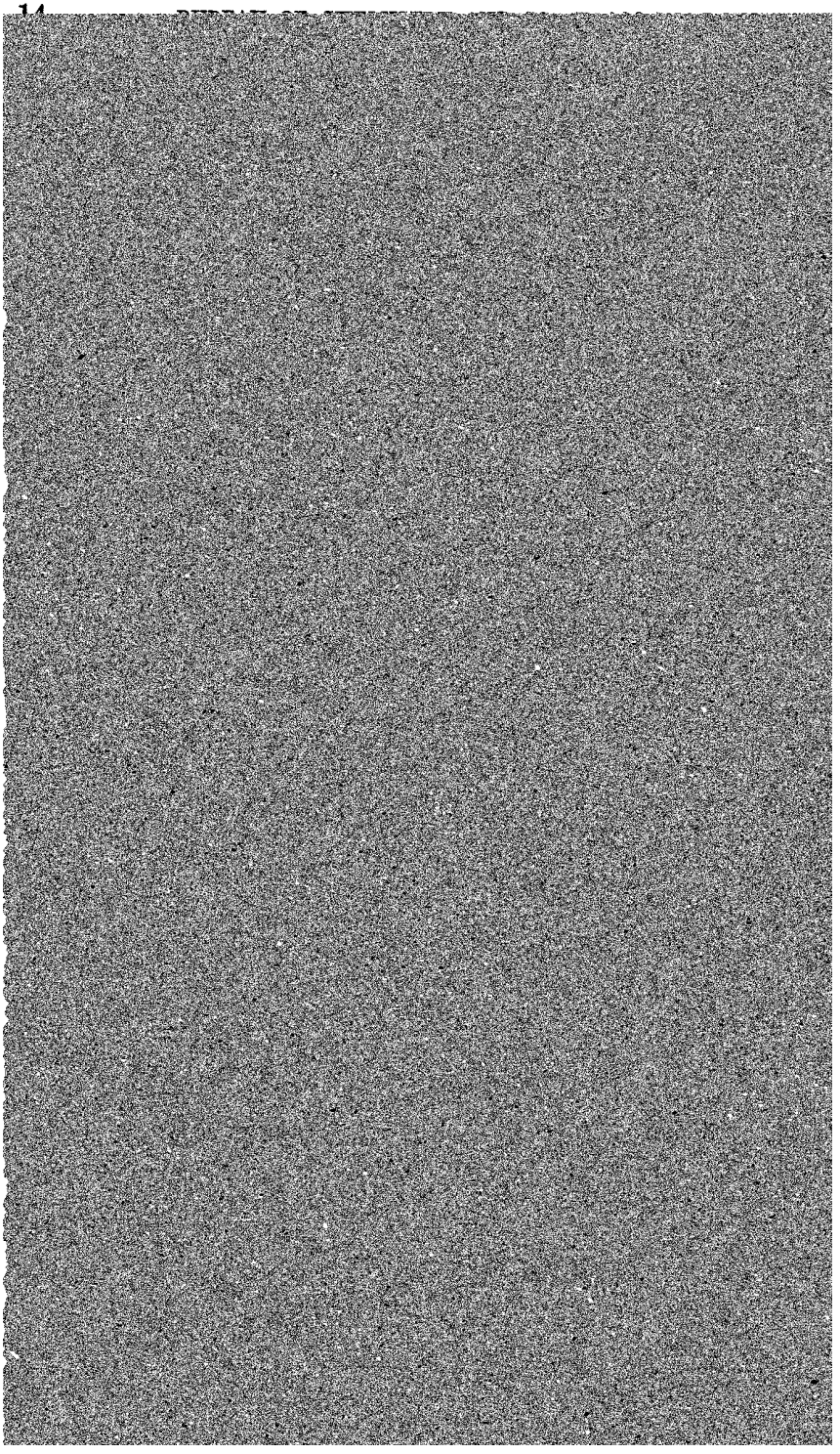
The greater part of Warren County has, from the earliest time, been covered by a luxuriant growth of grass, a vegetation that flourished under the influence of an abundant moisture supply. With the decay of these grass roots year after year, large quantities of finely divided carbonaceous material have been thoroughly mixed with the mineral





clay loam, mottled with dark gray, brown, and yellow. The different members of the Muscatine series, which are found throughout the gently undulating uplands, have been formed under slightly better drainage conditions than the Grundy soils and occupy an intermediate position between the Tama and Grundy soils. The surface soils and upper subsoil layers have been formed under moderately good drainage conditions, but drainage below the 27-inch depth has been somewhat restricted. The result is more thoroughly oxidized surface soils underlain, at a depth of 2 or 2½ feet, by slightly mottled subsoils. Included in the general group of soils developed under conditions of excessive moisture are the Bremer soils of the terraces and the Wabash soils of the first bottoms.

Originally Warren County was no doubt entirely covered with a luxuriant grass vegetation. With the passing of time erosion was active along some of the larger streams and this resulted in better drainage, which allowed more through oxidation, leaching, and aeration. Consequently the grass vegetation disappeared, and in its

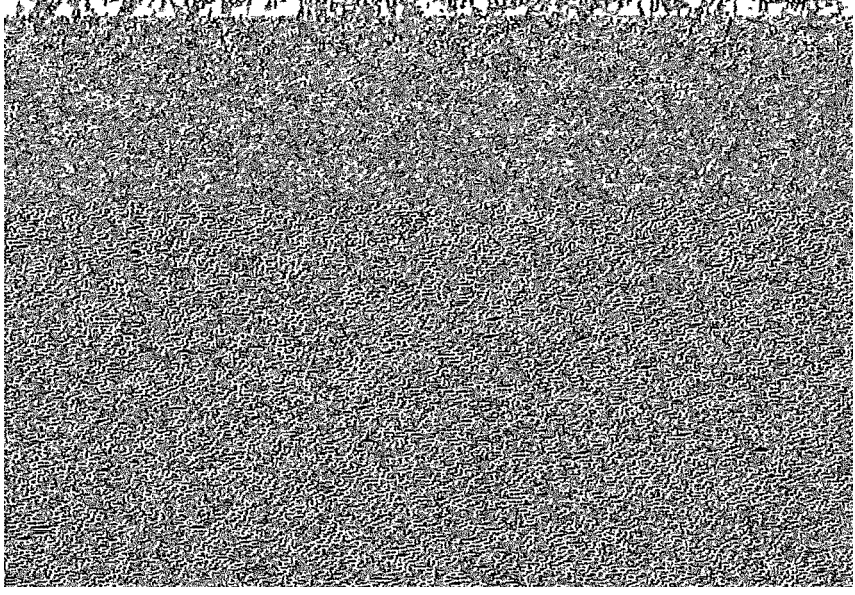


The lower subsoil layer, which is in most places 2½ or 3 feet thick, differs from the layer above in that faint gray mottles and iron stains occur and gradually increase in number with depth. Below this layer is the parent material, consisting of brown, yellowish-brown, or yellow heavy silt loam, faintly mottled with gray. In the upper part of the substratum the structure is somewhat platy but at a greater depth the mass is practically structureless. These soils have been leached of carbonates to such an extent that no effervescence was observed with dilute acid, even in the deepest cuts. The cultivated areas, which constitute approximately 95 per cent of the total area of this soil in the county, differ from the foregoing description in that the surface soil, to a depth varying from 14 to 18 inches, is friable silt loam, brown or dark brown when dry and dark brown or almost black when wet.

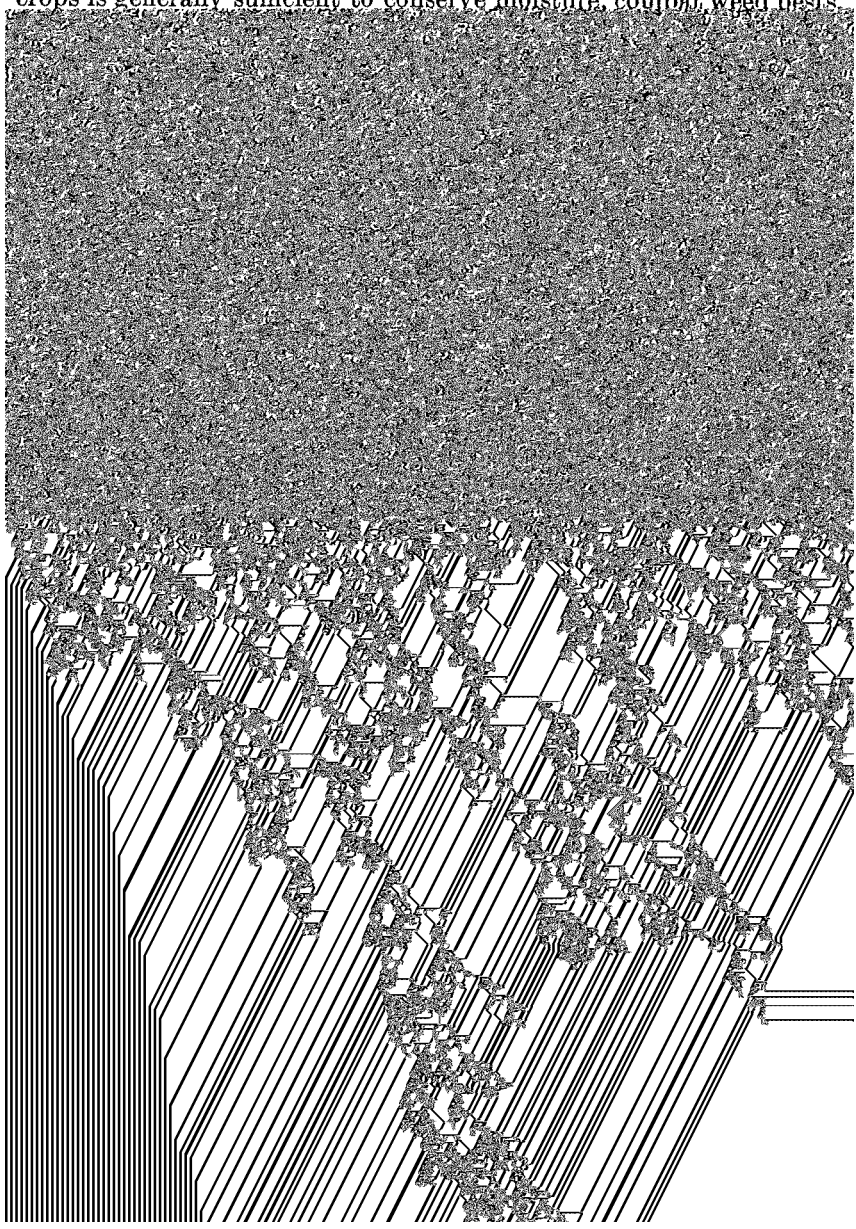
The profile of Tama silt loam is rather uniform throughout the county, the only variations occurring where this soil is associated with Grundy and Muscatine soils. In transition zones along such boundaries, the lower part of the subsoil is more strongly mottled with rust-brown iron stains. Included in mapped areas of Tama silt loam are very small patches of Muscatine silt loam and Grundy silt loam of such slight importance that separation was considered unnecessary.

Tama silt loam is the predominant upland soil north of an arbitrary east-and-west line through Indianola, and smaller isolated areas occur in the southern part of the county. In the northern half the areas are extensive and are broken only by narrow ribbonlike patches of Carrington silt loam and Carrington loam along the lower slopes of streams and Wabash silt loam bordering the streams.

The greater part of this soil is undulating or gently rolling. Even throughout areas of greatest relief, in the vicinity of Hartford in the northeastern corner of the county and Martensdale near the western



Tama silt loam in general receives very good treatment. Practically all small-grain stubble land and sod land is plowed in the fall, as fields are seldom damaged by winter rains. The corn stover remaining after the grain is harvested is used for forage. In the spring the cornstalks are cut with a disk harrow, and the fields are then broken and prepared for corn and small grain. The depth of plowing ranges from 4½ to 6 inches and in general the seed bed is put in a good pulverulent condition. Cultivation of the different grain and hay crops is generally sufficient to conserve moisture, combat weed pests,



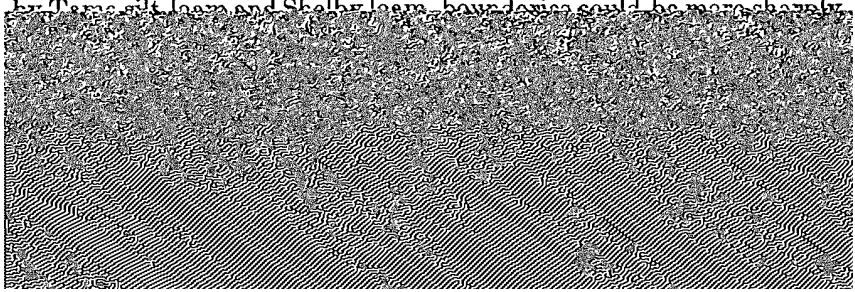
with typical Tama silt loam respond well to cultivation, though yields are slightly lower than on the typical soil.

Erosion is a serious menace, and in handling the soil of this phase much more care must be exercised than with the typical soil. Plowing should be at right angles to the slopes, as this will prevent surface wash to some extent. It is also best to leave the fields with cover during the winter. All gullies should be dammed with brush or concrete dams, a practice that is now in use on the better farms.

GRUNDY SILT LOAM

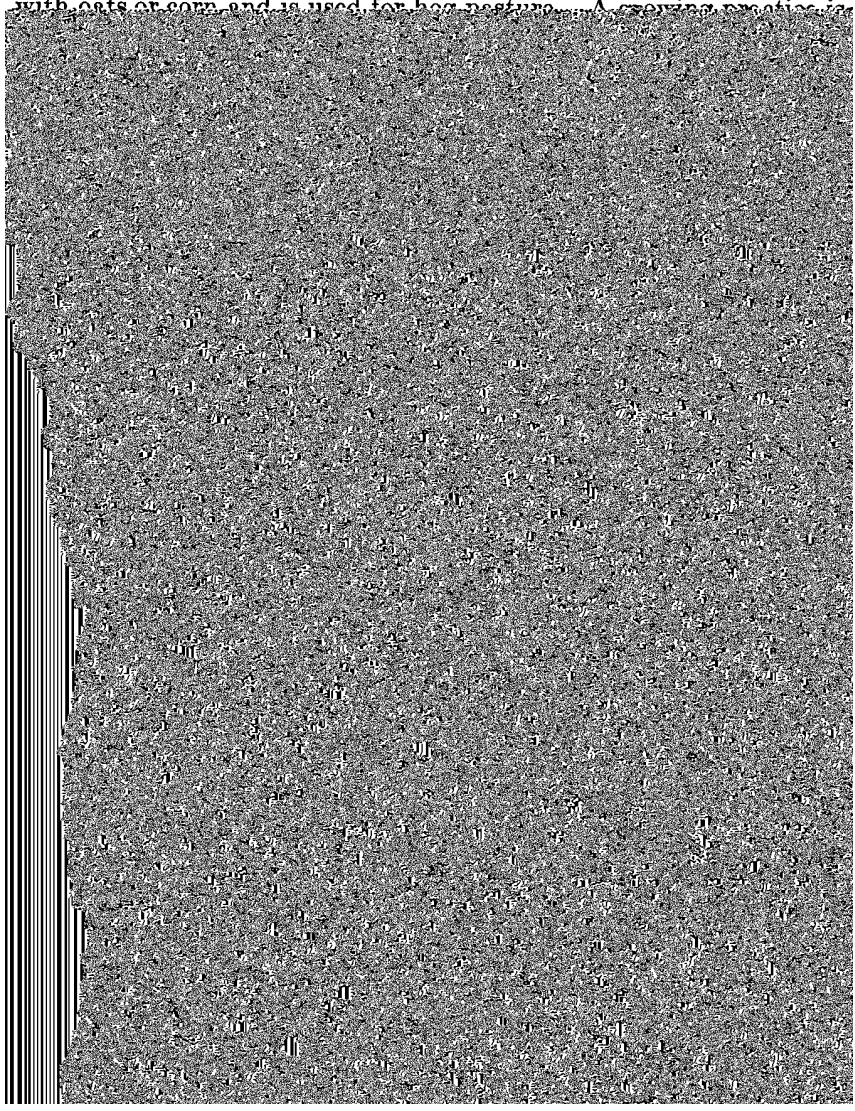
Typical Grundy silt loam, in Warren County, has a very dark grayish-brown surface layer 3 or 4 inches thick which has a somewhat platy structure. The subsurface layer, which continues to a depth of 10 or 12 inches, is slightly darker colored and has a finely granular structure. This darker color is probably caused by the accumulation of greater quantities of carbonaceous material. Below this layer is a third layer, 6 or 8 inches thick, which has a finely granular structure. The particles appear black, owing to the presence of a thin coating, but when they are crushed between the fingers the mass is rust brown or dark grayish. The lower subsoil layer, which begins rather abruptly at a depth of 18 or 20 inches and continues to a depth varying from 24 to 28 inches, consists of dark grayish-brown or slate-colored heavy plastic silty clay. The mass breaks down into subangular nutlike particles which are coated more or less with a dark-brown or black film. This layer grades into mottled gray, rust-brown, and yellow somewhat crumbly silty clay, in most places 10 or 12 inches thick, which is mottled with bright-yellow splotches and iron stains. Below this layer and continuing to a depth of nearly 5 feet the soil aggregates decrease in size, the texture becomes less heavy, and the color is predominantly drab and yellowish gray. The parent material consists of gray structureless heavy silt loam splotched with dark brown and yellow. Minor variations in the thickness of the surface layer and in the color of the upper subsoil layer occur in different parts of the county.

As little of this soil remains in the native condition, observations of the virgin soil were few. Plowing has altered the soil to a depth of only a few inches, and the surface soil commonly consists of dark-brown or almost black friable silt loam 16 or 18 inches thick. The content of organic matter is high, and when wet the fields appear decidedly black. Grundy silt loam is associated with Muscatine silt loam in many places, and the transition from one soil to the other is so gradual that separation was necessarily arbitrary. Where bordered by Tama silt loam and Shelby loam, boundaries could be more sharply

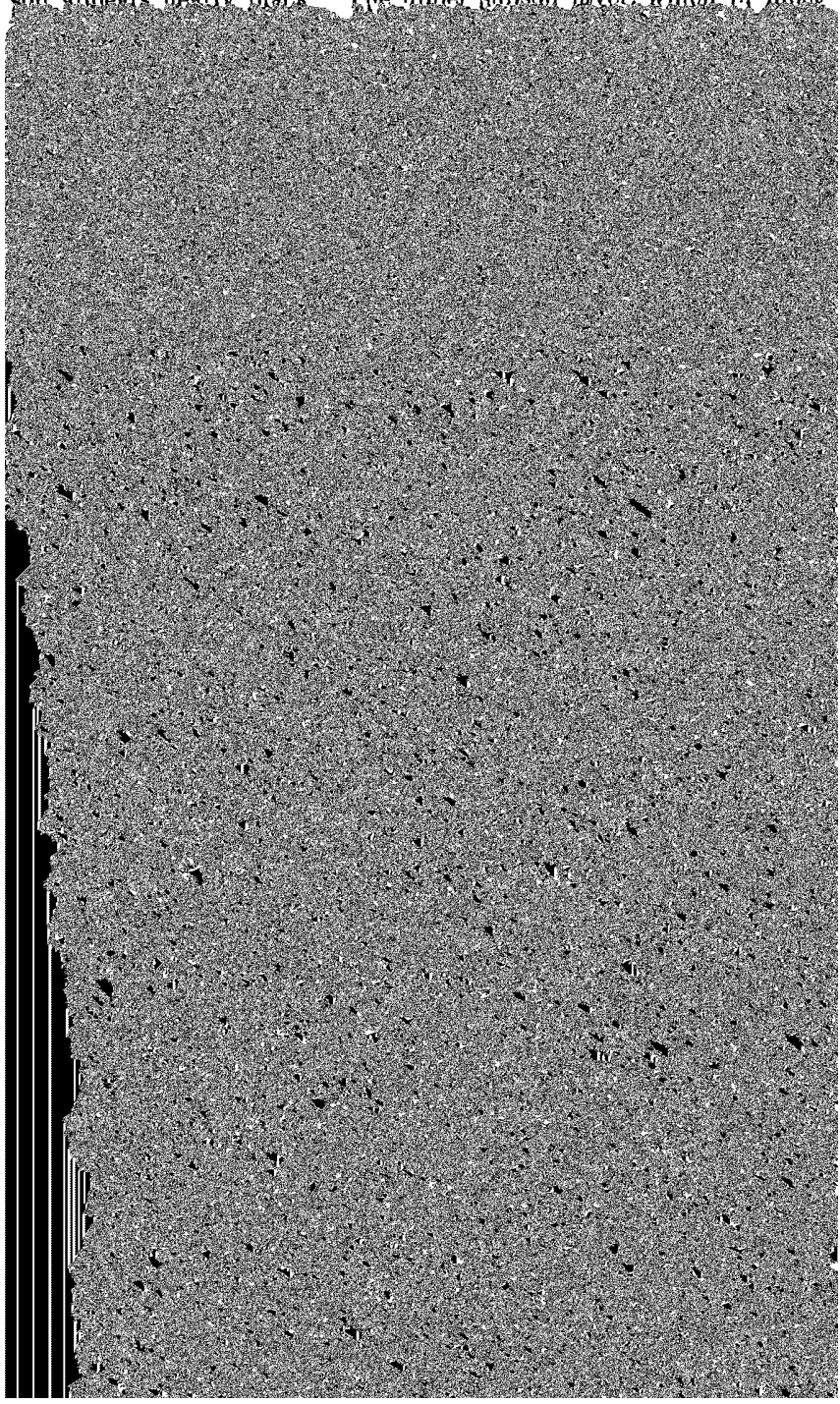


cent, is devoted to the production of staple crops or is used as pasture land. The only tree growth is a few willows along old fence rows, Osage-orange hedges, and windbreaks that have been set out to the north and west of farm dwellings.

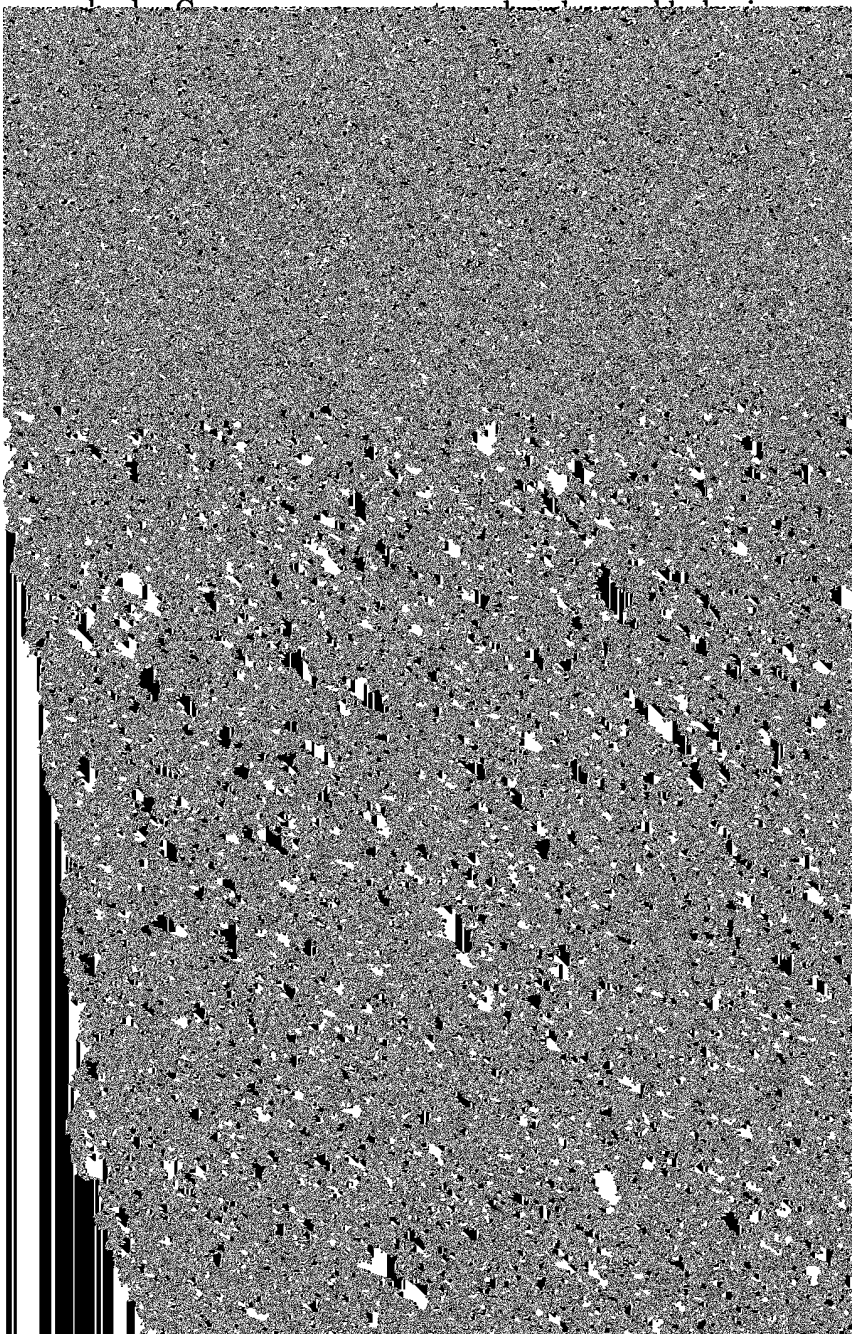
Corn is the principal crop and occupies the largest acreage. The grain is all used on the farms as feed for the work animals, beef cattle, and hogs. Wheat ranks second and oats third in importance. Wheat is the principal cash crop and is all shipped through the elevators to outside markets, whereas oats are used locally for feed. A large acreage of hay, mostly timothy and clover, is grown for use on the farms. Barley and rye are occasionally included in the crop rotation, and several fields of rape were observed. This crop is sown with oats or corn and is used for hog pasture. A sowing practice is



soil appears nearly black. The upper subsoil layer, which in most



Thorough drainage of this soil is necessary, and tiling of all fields is recommended. A larger acreage should be devoted to legumes, and corn should not be grown more than two years in succession on the



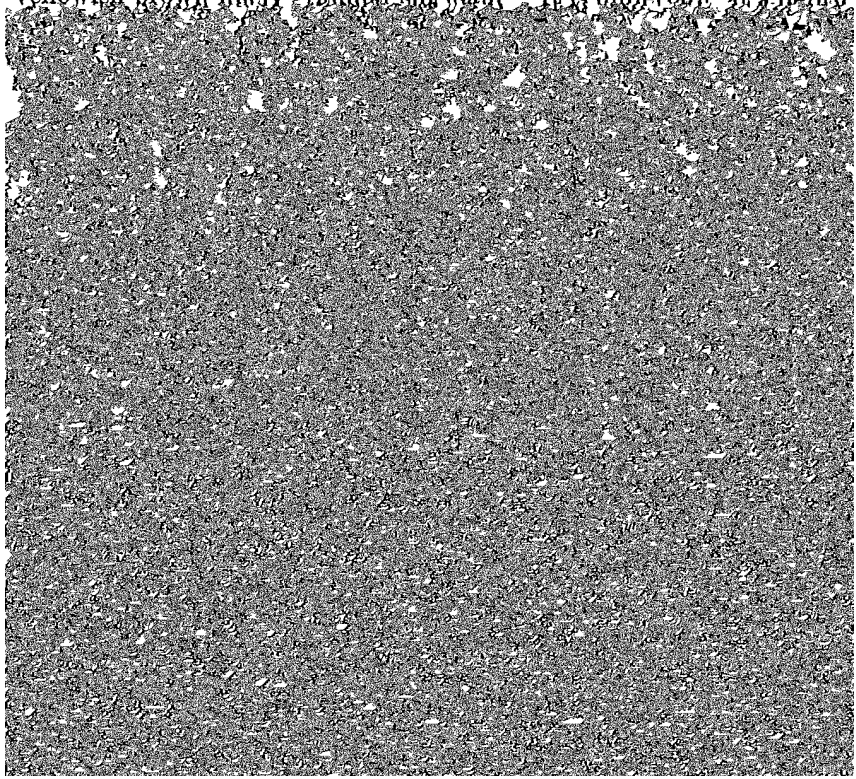
observed. The principal livestock industries are hog raising, raising and feeding of beef cattle, and, less extensively, dairying. Several small flocks of sheep are kept, principally for the production of wool, though a few lambs are sold yearly.

Well-improved Clinton silt loam is valued at prices ranging from $125 to $175 an acre, depending on location and the character of the improvements. Unimproved land has a much lower value.

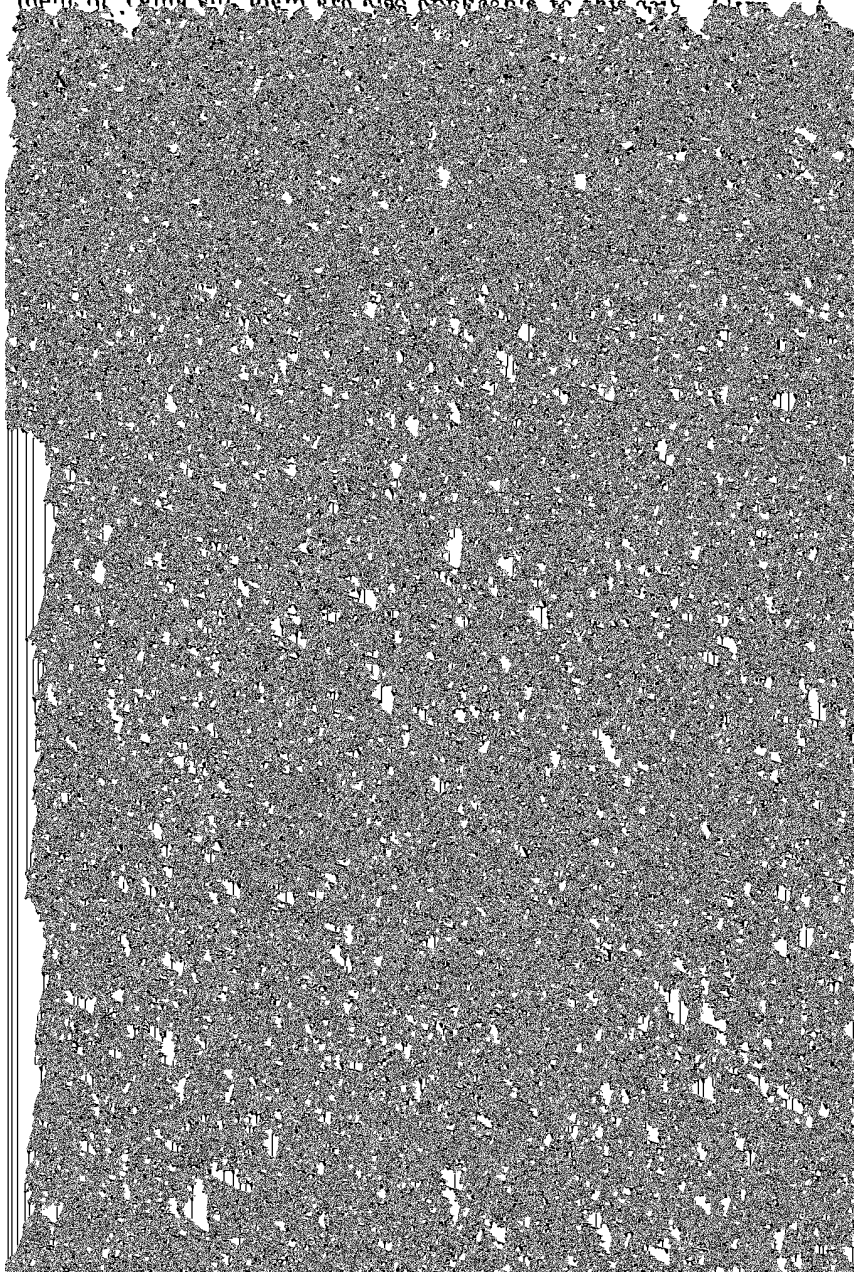
This soil is prevailingly poor in organic matter, and improved cultural methods that will add to the present store should be employed. Green-manure crops, preferably legumes such as sweet clover and red clover, should be more extensively grown and turned under. Stable manure should also be more carefully saved and applied in the fall before plowing. In the rougher areas tillage operations should be so conducted as to reduce the damage done by erosion. As both surface soil and subsoil are acid, the use of ground limestone should prove of great value.

CARRINGTON SILT LOAM

The surface soil of Carrington silt loam, in the virgin state, consists of two distinct layers, a dark grayish-brown even-textured silt loam layer 2 or 3 inches thick, which contains an abundance of grass roots, and a dark grayish-brown or very dark grayish-brown mellow, friable granular silt loam layer which continues to a depth of 12 or 14 inches without change. The upper subsoil layer is dark-brown or dark yellowish-brown finely granular silt loam. It is underlain at a depth



Carrington silt loam is practically all in cultivation or in pasture. The only tree growth consists of windbreaks that have been set out to the north and west of farm dwellings. This is considered a valuable agricultural soil and is handled in practically the same manner as the adjoining Tama silt loam. Methods suggested for the improvement of Tama silt loam are also applicable to this soil. Corn [illegible]



Land of this kind is always sold with the adjoining Tama silt loam. The value is slightly less than of that soil.

CARRINGTON FINE SAND

The surface soil of Carrington fine sand is medium dark grayish-brown or very dark grayish-brown fine sand or loamy fine sand which contains a large percentage of organic matter. This layer is 6 or 8 inches thick and grades into the subsoil layer which consists of yellowish-brown or yellowish loose-textured fine sand that continues to a depth of 4 or 5 feet without appreciable change.

Where this soil occurs in close association with Tama silt loam and Shelby loam the color is predominantly darker, but in sections 8 and 35, T. 77 N., R. 22 W., the surface has much the same color as the adjoining Clinton silt loam and Lindley silt loam. Along the Lucas County line in section 36 of Whitebreast Township, the typical soil consists of dark-brown loose-textured loamy fine sand underlain at a depth of 10 or 12 inches by yellowish-brown sticky fine sand which in turn grades, at a depth of 20 or 22 inches, into a fine sand and gravel layer.

Carrington fine sand, which is of small extent, occurs in close association with the Tama silt loam and Clinton silt loam of the uplands. The two most extensive areas are 2 miles northeast of Summerset along the south side of Middle River and south of Norwalk on the south side of North River. Smaller isolated areas occur in Richland and Whitebreast Townships.

The surface of this soil is rolling or broken, and erosion has gullied many of the slopes. Drainage is excessive, and the soil is droughty.

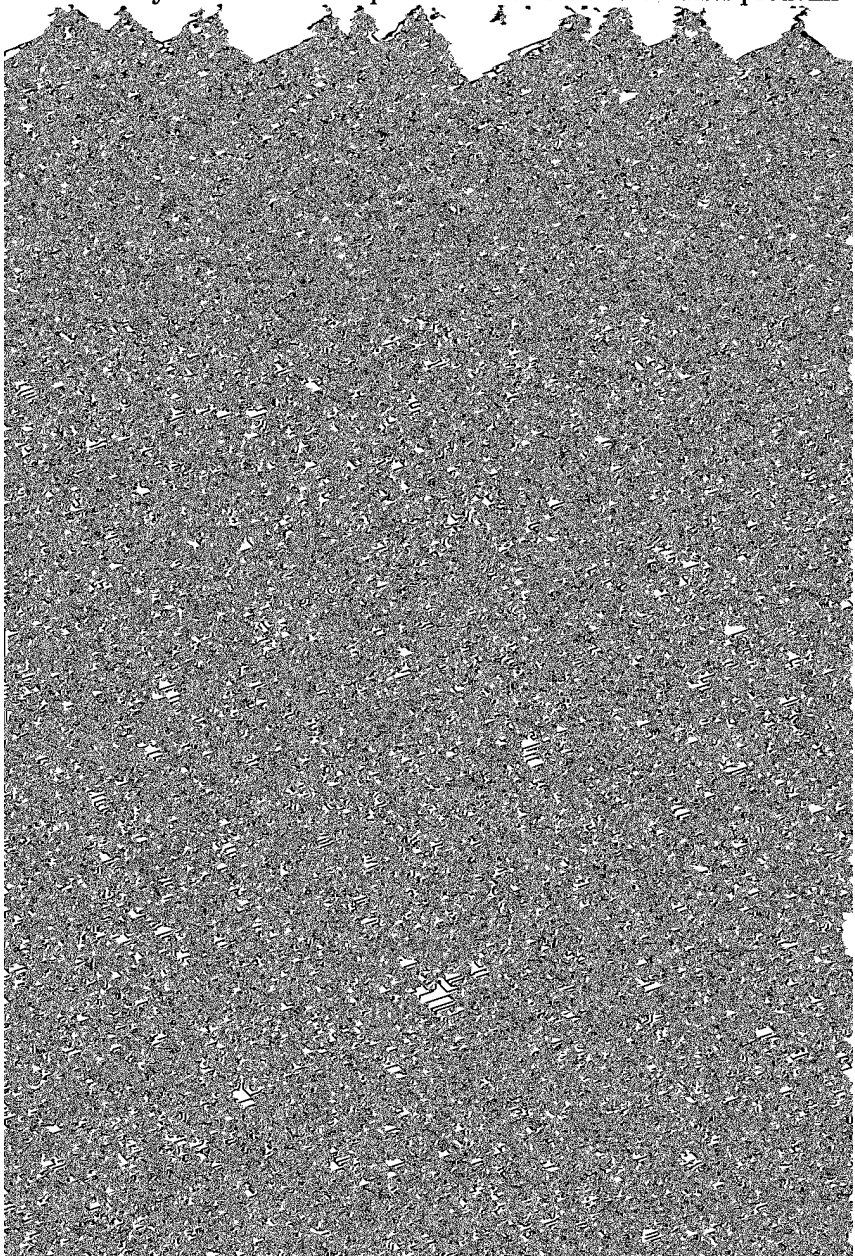
Carrington fine sand is considered a good soil for the production of melons and truck crops, and the greater part of it is used for this purpose. The surplus melons are either peddled in the near-by towns or hauled to Des Moines, but the vegetables are all used on the farms. Corn occupies a small acreage, and some clover is grown. However, owing to the droughtiness of the soil, yields are low except in wet years. Native pastures are of little value, as the grasses make an indifferent growth. The virgin areas support a scant growth of native grasses, with some oak and jack pine trees.

This soil is farmed in practically the same manner as the adjoining Tama silt loam. On account of the open porous structure it warms up before the heavier soils and may be cultivated earlier. Crop rotations are seldom followed, except in the vicinity of Norwalk. Here melons are alternated with red clover, the clover serving as a green-manure crop. Stable manure is used to some extent as a fertilizer for melons.

SHELBY LOAM

The surface soil of Shelby loam is dark grayish-brown or very dark grayish-brown fine-textured loam, 1 or 2 inches thick. This layer is underlain, to a depth varying from 5 to 7 inches, by a slightly darker colored, finely granular layer. The upper subsoil layer, which in most places underlies the layer above rather abruptly, consists of yellowish-brown silty clay loam or gritty silty clay mottled with gray, rust brown, and a few iron stains. The three layers are predominantly acid, as leaching has removed the carbonates from them. Below a depth of 20 or 24 inches and continuing in most places to a

depth of 3½ or 4 feet is a fourth layer, consisting of yellowish-brown sandy clay mottled with rust brown, gray, and some red. Partly disintegrated rock fragments, many of them containing carbonates, also occur in various quantities. As in the layers above, this mass breaks down to small aggregates measuring one-fourth or one-eighth inch in diameter, forming what is commonly called a nut structure. The fifth layer occurs at a depth of 4 or 5 feet and consists predomi-



more gentle slopes. Where the slopes have been gullied, brush and concrete dams would aid in their reclamation.

Land of this kind is always sold with Tama silt loam and Grundy silt loam. It is not considered nearly so valuable as either of the other soils mentioned.

SHELBY SILT LOAM

The surface soil of Shelby silt loam consists of dark grayish-brown mellow finely granular silt loam, from 5 to 7 inches thick. The subsoil is yellowish-brown gritty sandy clay loam which is underlain, at a depth of 24 or 26 inches, by yellowish-brown or light-brown gritty clay mottled with yellowish brown, gray, and red. Fragments of the parent till, including lime-bearing materials, occur in streaks near a depth of 3 feet. The weathered layers have a distinct nut or coarsely granular structure.

This soil differs from Shelby loam in surface characteristics only, owing no doubt to topographic position. It occurs typically around the heads of drainage ways, and the slopes are less steep and are somewhat shorter than in the loam. This feature has allowed the accumulation of greater quantities of silt. Like Shelby loam it is an erosional soil and necessarily includes a number of textural variations. Included with mapped areas of this soil are a few areas of Carrington silt loam and Carrington loam of such small extent that separation is impossible.

The surface is less rolling than that of Shelby loam, and gullies and water furrows are not so common. Surface drainage is inclined to be excessive, but the subsoils are retentive of moisture, and crops seldom suffer from drought.

Shelby silt loam occurs only in the southeastern and northwestern parts of the county. The most extensive areas are along the south side of Middle River north of St. Marys. The areas are comparatively small and isolated.

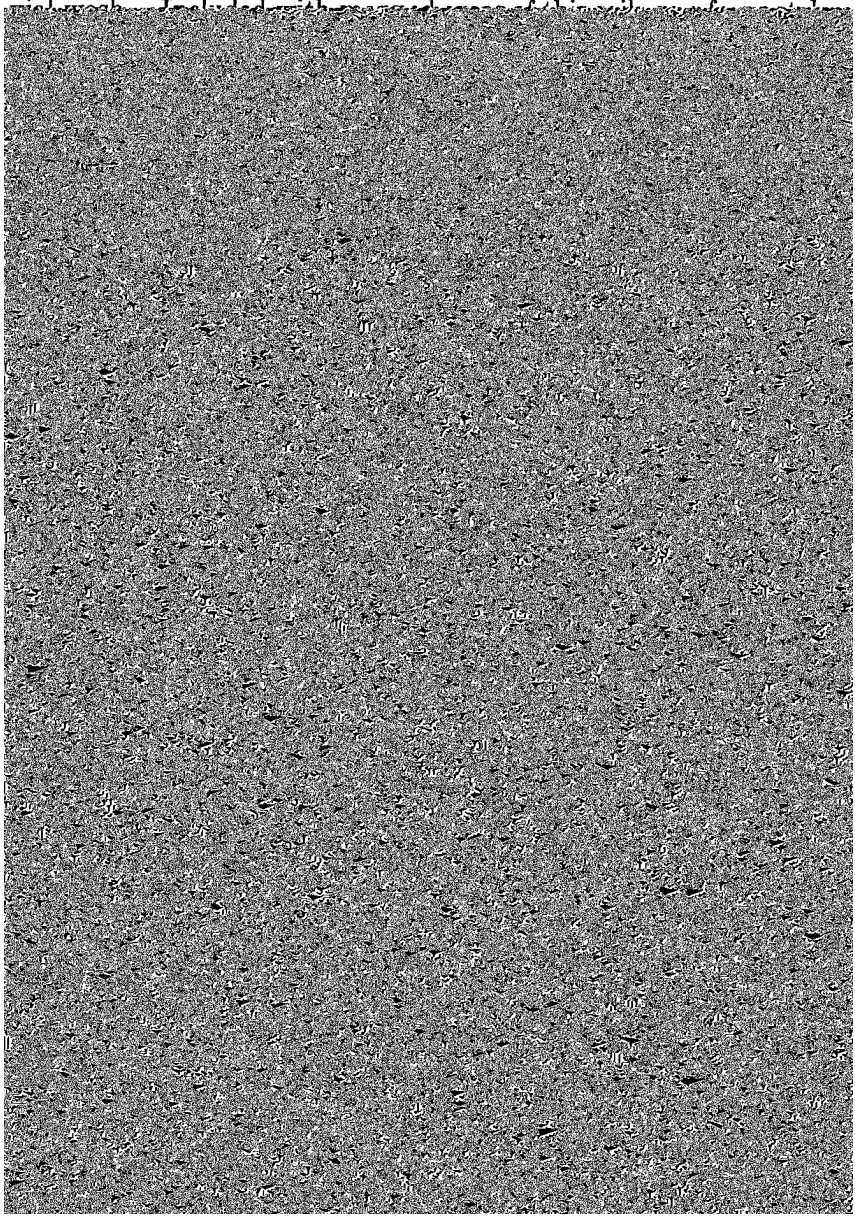
Approximately 50 per cent of this soil is under cultivation and the remainder is left in its natural condition and used for pasture. Corn, oats, and hay are the principal crops. Yields are somewhat lower than those obtained on the adjoining Grundy silt loam and Tama silt loam. Farm practices, however, are the same. A few hogs and cattle are pastured.

Shelby silt loam should be devoted more extensively to pasture. Bluegrass makes an excellent growth and a much larger acreage should be planted to this crop. Gullied areas may be reclaimed by building brush and concrete dams.

LINDLEY SILT LOAM

The surface soil of Lindley silt loam, to a depth of 1 or 2 inches, consists of brown or grayish-brown silt loam which contains a large quantity of humus. This is underlain by a light brownish-gray or pale yellowish-gray floury silt loam layer, 3 or 4 inches thick in most places. This layer is underlain rather abruptly by the true subsoil. The upper part of the subsoil is pale yellowish-brown silt loam with a crumbly or coarsely granular structure, and the lower part, below a depth of 16 or 18 inches, is bright-yellow or yellowish-brown compact friable silty clay or fine sandy clay slightly mottled with faint

featherings of gray. Compactness increases with depth, and when dry chunks of the lower subsoil layer are broken up the mass has a distinct subangular appearance, the aggregates measuring one-fourth inch or more in diameter. The number of fragments of the parent till increases with depth. Many of these rock fragments contain carbonates and the soil near a depth of 3 feet is distinctly calcareous in many places. In some areas midway of some of the steeper slopes nearly all the surface covering has been washed away, whereas near the bottom of the slopes the soil is somewhat deeper, owing to collu-



Practically all of this soil is used for the production of staple crops or for pasture. Corn is the principal crop and occupies the largest acreage. Yields range from 38 to 45 bushels to the acre, though on improved lands yields of 65 and 85 bushels are not uncommon. Wheat, oats, clover, and timothy are also important crops. All the corn, oats, and hay are used on the farms as feed for the work animals, hogs, and cattle, but wheat, the principal cash crop, is sold in outside markets. Farm practices are similar to those in use on Tama silt loam.

Waukesha silt loam is naturally a rich soil, and under proper management its fertility may be maintained and increased. Definite crop rotations including legumes should be followed. Green-manure crops should also be grown. Applications of ground limestone have proved beneficial, and it is recommended that the use of this material be extended. Limestone not only corrects the acidity but improves the physical condition of the soil. Deeper plowing and more thorough preparation of the seed bed are also necessary.

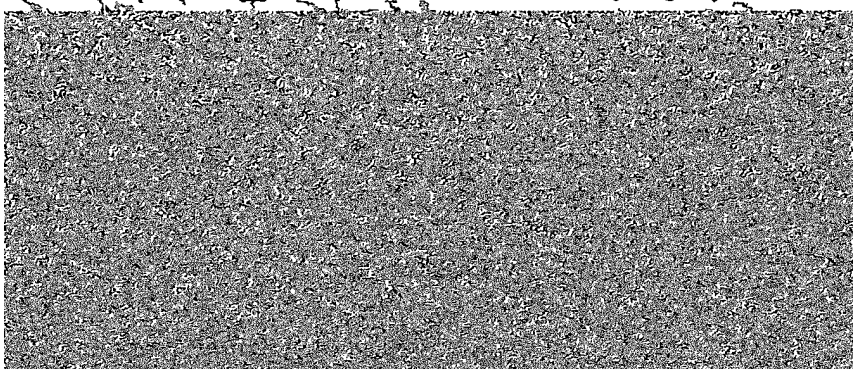
WAUKESHA LOAM

Waukesha loam has a surface soil of dark grayish-brown or very dark grayish-brown friable loam from 15 to 18 inches thick. Beneath this layer and continuing to a depth of 20 or 22 inches is the upper subsoil layer of finely granular brown or yellowish-brown loam. This layer is underlain by yellowish-brown fine sandy clay loam which continues to a depth of 38 inches, where it grades into a layer of yellowish loamy fine sand.

Waukesha loam occurs only on the terraces of Des Moines and North Rivers. Except for one area, just east of Carlisle, which includes about 40 acres, the soil occurs as small knolls scattered throughout areas of Bremer silt loam.

Areas of Waukesha loam have level or gently undulating surfaces. Drainage is well established and is adequate for crop needs during favorable seasons. Owing to the presence of a substratum of fine sand, the subsoils are not so retentive of moisture as those of Waukesha silt loam.

The greater part of this soil is under cultivation, and because of its friability it is easily tilled. It warms up earlier than the adjoining Bremer silt loam and therefore allows earlier planting and maturity of the crops. The staple crops, corn, oats, and hay, are grown and under favorable seasonal conditions yields are only slightly less than



gray, and yellowish brown. Mottles increase with depth, and iron concretions are numerous in many places. The soil is fairly uniform throughout the county. The surface soils naturally vary somewhat in texture and thickness, but not sufficiently to necessitate the separation into other soil types. Along the outer edges of the areas bordered by Shelby loam, the soil is more friable, owing to inwash of greater quantities of sand. Some included areas resemble loam and silty clay loam in texture. The subsoils vary only in the number of mottles in the lower parts.

Bremer silt loam occurs on the terraces of all the rivers and larger creeks of the county, principally in the vicinity of Carlisle, west of Summerset, and in the northern part of Allen Township. The surface is flat or very gently sloping toward the streams. Ordinarily the soil occupies a position about 2 or 3 feet above the first bottoms, but in many places the merging of the terraces and first bottoms was so gradual that boundaries were difficult to draw.

Owing to the compactness of the subsoil, drainage of this soil is only moderately well developed. This condition has been overcome, in a number of places, by the construction of open ditches and the installation of tiles.

Bremer silt loam, where well drained, is considered a valuable agricultural soil, and approximately 80 per cent of it is under cultivation. The remainder is left with its natural cover of grass and is used for pasture. A few areas are wooded with willow, oak, cottonwood, and elm.

Corn, oats, wheat, and hay are the principal crops, corn occupying the larger acreage. Oats and wheat do well, especially wheat. All the corn, oats, and hay are used on the farms as feed for the beef cattle, hogs, and work animals commonly kept, and the wheat is sold to outside markets. Corn yields from 38 to 45 bushels to the acre, though much larger yields are reported; oats from 35 to 55 bushels; wheat from 20 to 30 bushels; and hay 1½ or 2 tons.

The methods of managing this soil are similar to those in use on Grundy silt loam. No barnyard manure or commercial fertilizer is used.

Drainage is of great importance. All fields should be well tiled and ditched to allow freer movement of the drainage waters emptied at the back of the benches. Crop rotations in which legumes are used as green-manure crops would also improve the fertility and physical condition of the soil.

Land of this kind is usually sold with the adjoining Shelby loam, Tama silt loam, and Wabash silt loam, and the proportion of each soil included on a farm influences the selling price.

BREMER SILTY CLAY LOAM

Bremer silty clay loam consists of a dark-brown or almost black surface layer 10 or 12 inches thick, which is somewhat crumbly silty clay loam in texture. This is underlain to a depth of 3 or more feet by dark slate-colored or dark brownish-gray heavy compact silty clay which contains some iron stains and iron concretions. The organic-matter content of the surface layer is high, and when wet the fields are decidedly black.

This soil occurs only on the terraces of Des Moines, North, and South Rivers in a position slightly lower than that of the adjoining

Bremer silt loam and 1 or 2 feet higher than that of Wabash silt loam. The largest area is approximately 2½ miles northeast of Summerset. Three smaller areas occur in the vicinity of Carlisle. The surface is flat or very gently sloping. Natural drainage is poor, and tiling is necessary.

Bremer silty clay loam is of slight agricultural importance. However, it is all under cultivation and is farmed in conjunction with the adjoining Bremer silt loam. The soil is more difficult to handle and greater care must be taken to plow under proper moisture conditions. Yields are lower than on the silt loam.

Soil of this kind may be improved by the incorporation of greater quantities of humus. More thorough tiling is recommended, and it is necessary to place the laterals closer together than in the lighter textured soils. A small quantity of ground limestone was applied to this soil during the year of the survey, and as the soil is acid lime will no doubt prove beneficial.

BREMER LOAM

The surface soil of Bremer loam in Warren County is friable loam rich in organic matter. It is very dark brown when dry and black when wet. The organic-matter content disguises the texture in many places, and separation from the adjoining silt loam was difficult. The upper subsoil layer is grayish-brown silty clay loam, which at a depth ranging from 20 to 28 inches grades into yellowish-brown, gray, and rust-brown much heavier textured material. The surface soils of the higher areas are slightly lighter in color, and the lower subsoil layers are more strikingly mottled with yellow. Along the Polk County line in the extreme northeastern corner of Allen Township, some fine grit is present in the lower part of the subsoil. Both surface soil and subsoil are acid in reaction. Included with mapped areas of this soil are a few very small patches of Bremer silt loam and Bremer silty clay loam.

Bremer loam occurs in only four comparatively small areas east and northeast of Carlisle. All of the land is under cultivation. It is farmed in conjunction with Bremer silt loam and is managed similarly. Owing to its friability and mellowness, it warms up earlier than the silt loam and can be plowed under a wider range of moisture conditions. Crop yields are about the same as on Bremer silt loam.

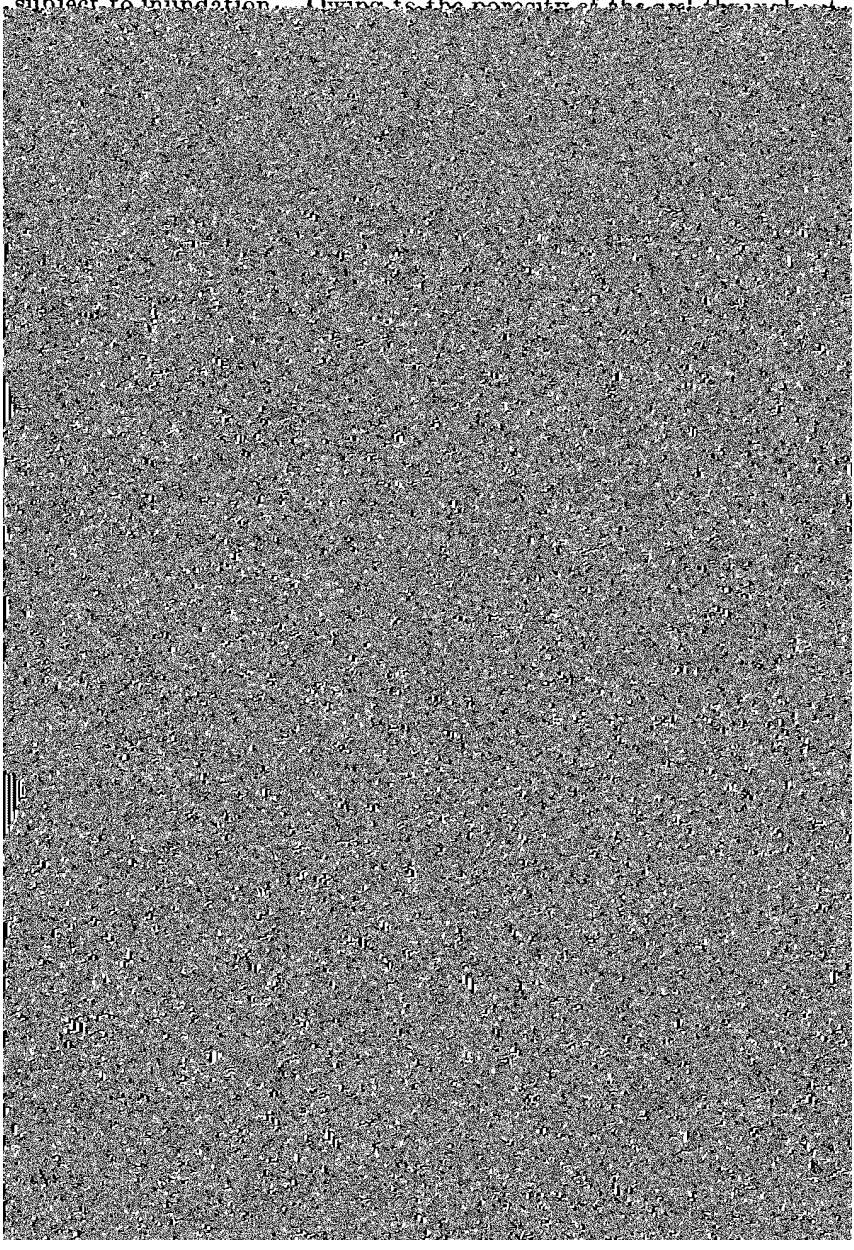
The value of Bremer loam is practically the same as that of Bremer silt loam, with which it is commonly sold.

JUDSON LOAM

The surface soil of Judson loam consists of dark-brown or dark grayish-brown friable loam 16 or 18 inches thick. This is underlain, to a depth of 3 or more feet, by material which differs from that above in that the color becomes more yellowish with depth. The cultivated fields are black when wet. Leaching has entirely removed the carbonates.

Slight variations in color and texture occur in this soil. Included in mapping are a few inextensive areas of Judson fine sandy loam. These included areas are in sections 14 and 23, T. 76 N., R. 25 W. and in section 15, T. 77 N., R. 23 W. Combined with this soil also is one small area of Judson silt loam in sections 35 and 36, T. 77 N., R. 22 W.

This soil occurs as small isolated areas on the terraces of Middle River and Coal Creek. It lies slightly higher than the adjoining Waukesha silt loam and is 2 or 3 feet above the level of the first bottoms. The surface is flat or very gently sloping, but the land is subject to inundation. Owing to the porosity of the soil the [illegible]



JACKSON SILT LOAM

The surface soil of Jackson silt loam in Warren County consists of a layer, varying from 8 to 12 inches in thickness, which is prevailingly gray or brownish-gray friable silt loam. This layer is underlain by brown or yellowish-brown friable silt loam or loam which also varies from 8 to 12 inches in thickness. At a depth ranging from 20 to 24 inches the second layer grades into pale-yellowish heavy silt loam or friable clay loam which continues to a depth of 3 or 4 feet with little change other than an increased number of brown mottles and a few iron stains. Neither surface soil nor subsoil shows any trace of lime. Many very small areas of loam and fine sandy loam too intricately mixed to separate have been included in mapped areas of Jackson silt loam.

Jackson silt loam has a total area of 192 acres. It occurs only as small isolated patches on the terraces of Des Moines and South Rivers. It is 1½ or 2 feet above the first bottoms and 12 or 15 feet above the normal level of the streams and is beyond the reach of ordinary overflow. The surface is level, slightly hillocky, or ridgy, and drainage is good.

Approximately 95 per cent of this soil is under cultivation, and the remainder is covered by wild grasses and a scrubby growth of willow. Corn is the principal crop, but some wheat and clover are grown. Crop yields are less than those obtained on Waukesha silt loam. Corn yields from 32 to 36 bushels to the acre, wheat 12 or 15 bushels, and hay 1 or 1½ tons.

This soil is managed in practically the same manner as Waukesha silt loam. It is deficient in humus, and crop yields may be increased by growing and turning under an increased acreage of green-manure crops, preferably legumes. Systematic rotations should also be followed. As the soil is acid, ground limestone could be profitably used.

WABASH SILT LOAM

The surface soil of Wabash silt loam consists of dark grayish-brown or very dark grayish-brown, mellow, even-textured silt loam from 14 to 16 inches thick. The organic-matter content is generally high, and when wet the fields are intensely black. The subsoil is predominantly dark slate-colored or very dark grayish-brown silty clay loam or silty clay which grades, at a depth of 28 or 30 inches, into a layer distinctly mottled with iron stains, and containing variable quantities of iron concretions.

As is true in most first-bottom or overflow soils, numerous variations from the typical soil occur. South of Lacona along Mill Branch are a few areas that differ from typical in that the soil, to a depth of 2 or 3 inches, is light brown or grayish in color and the subsoil is not so heavy as typical. Similar small areas are mapped in section 26 of Richland Township. Along Clanton Creek half a mile southwest of Wick the soil to a depth of 12 or 15 inches is brown, mellow loam. This is underlain by dark-brown silty clay loam which grades abruptly, at a depth of 18 or 20 inches, into black silty clay. Where this soil occurs in association with the silty clay loam and silty clay members of the Wabash series the transition from one soil to

the other is gradual in many places, and the boundaries are somewhat arbitrarily drawn.

Wabash silt loam is the predominant first-bottom soil in the county. It is most extensive along North, South, and Middle Rivers where many areas range from one-fourth mile to 1½ miles in width. Along the creeks the bands are narrower, and few of the valley floors of the intermittent streams are more than 350 feet wide.

The surface of Wabash silt loam is predominantly level or gently sloping toward the streams. It lies 10 or 12 feet above the normal level of the rivers and 4 or 5 feet above the level of the creeks. Since the rivers and many of the larger creeks have been straightened and dredged general inundations are rare and the water backs up only in the low areas during flood periods. Along the smaller creeks overflows are more frequent, but the water remains on the land for a short time only. In few places is natural drainage sufficient, and tiling is necessary for best results.

Wabash silt loam is considered a strong, valuable soil where it is well drained. About 70 or 80 per cent of it is under cultivation or in pasture. The wooded areas support a tree growth which consists chiefly of cottonwood, elm, ash, oak, hickory, and some willow.

Corn is the principal crop and can be grown on the same ground without reduced yields for longer periods than on the upland soils. Average yields of between 40 and 45 bushels to the acre are obtained. The corn is all used on the farms for feed. Winter wheat is an important cash crop, and yields range from 18 to 28 bushels to the acre. Oats and hay, mainly clover and timothy, are also grown. Oats yield from 40 to 60 bushels and hay 1½ or 2 tons to the acre. The principal livestock industries are hog raising and the raising and feeding of cattle. Dairying is unimportant.

Wabash silt loam is managed in much the same way as Tama silt loam and Grundy silt loam of the uplands. Owing to its mellowness it may be easily plowed under proper moisture conditions, and an excellent seed bed may be maintained. Fields are seldom plowed when too wet or too dry, as the soil is likely to clod. Barnyard manure is used less extensively than on the adjoining uplands.

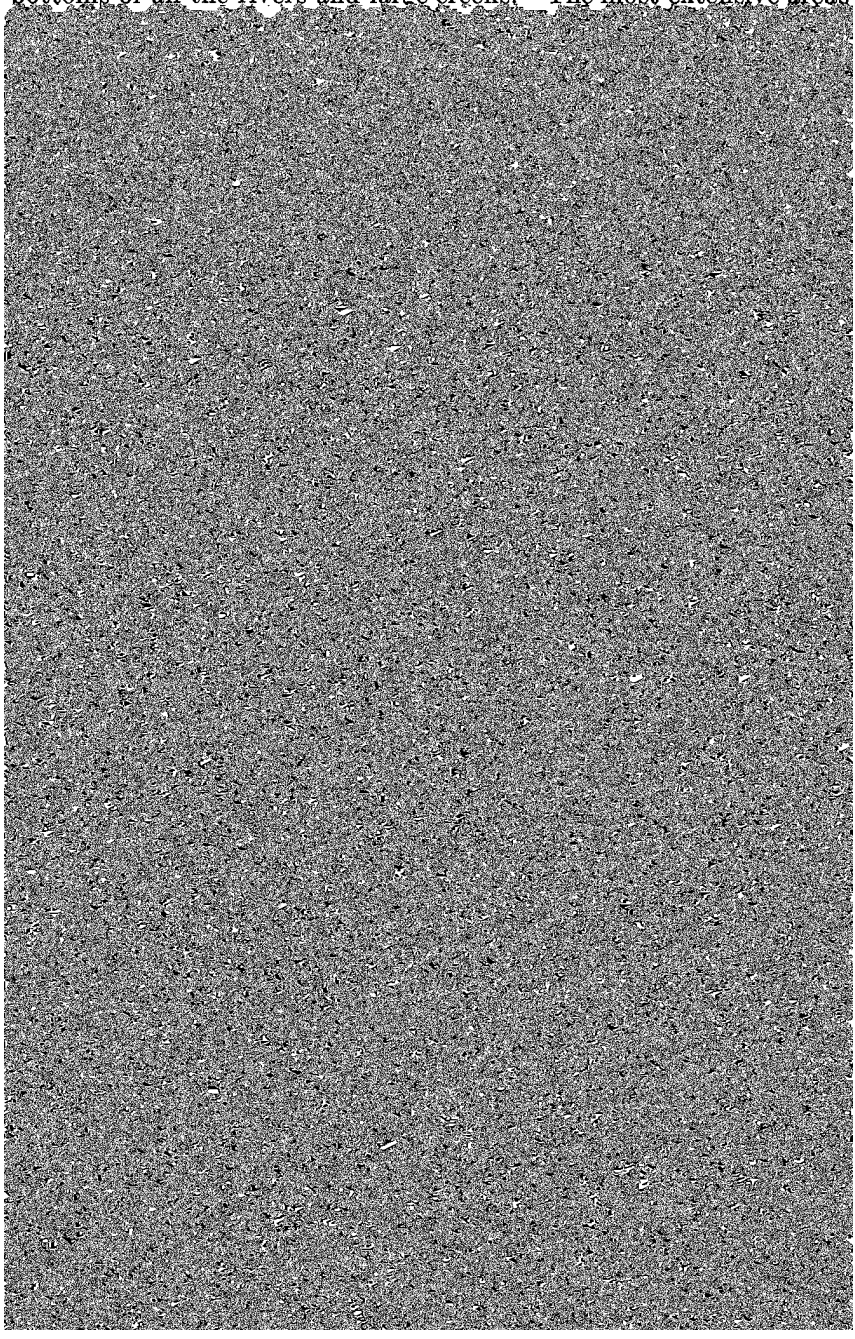
Land values of Wabash silt loam vary. Where well drained, improved, and conveniently situated it is held at prices ranging from $100 to $175 an acre.

Drainage is of first importance. Open ditches are sufficient in many places, but tiling would no doubt give best results. Deeper plowing and definite crop rotations are also recommended.

WABASH SILTY CLAY LOAM

The surface soil of Wabash silty clay loam is dark grayish-brown or very dark grayish-brown silty clay loam varying from 12 to 16 inches in thickness. When dry the surface is very dark grayish brown and is crumbly. The subsoil is dark slate-colored or dark brownish-gray silty clay loam slightly mottled with rust brown. In some places the surface soil is almost black and is heavier textured than typical, whereas in other areas the surface layer is medium dark brown in color. This soil resembles Wabash silt loam in all characteristics, except the texture of the surface soil, and in many places boundaries between the two soils were difficult to determine. Both

Wabash silty clay loam occurs as rather large areas in the first bottoms of all the rivers and large creeks. The most extensive areas



Better drainage and the incorporation of greater quantities of humus are necessary for the improvement of this soil. The use of ground limestone is also recommended.

WABASH LOAM

The surface soil of Wabash loam is dark grayish-brown mellow loam, 15 or 17 inches thick, which contains a high percentage of organic matter and silt. The subsoil is dark-brown loam that, at a depth of 22 or 24 inches, grades into brownish or dark grayish-brown friable clay loam faintly mottled with rust-brown splotches. Near a depth of 3 feet some particles of fine and coarse sand are present. Both the surface soil and subsoil are acid in reaction. Slight variations in the color and texture of the different layers also occur.

Wabash loam is inextensive. The largest area is 2½ miles southeast of Hartford in the bottoms of South River, and two small areas are just north of Carlisle along the Polk County line.

The surface is level, and the land lies at practically the same elevation as the adjoining Wabash silt loam. Drainage, except during periods of excessively high water, is usually sufficient for crop needs.

During the year of the survey (1925) approximately 80 per cent of the soil was under cultivation to corn. Yields of 40 or 45 bushels to the acre were obtained. In some years a small acreage of wheat and oats is grown with fair success. The wheat crop is more profitable than the oat crop. The wooded areas, which support a scant growth of willow, oak, elm, hickory, cottonwood, and locust, are used largely for pasturing the few head of cattle commonly kept.

Wabash loam is farmed in much the same way as the adjoining Wabash silt loam but is a little more easily cultivated and can be handled under slightly wider moisture conditions. Crop rotations are seldom followed, and corn is grown for several years before the ground is returned to small grain.

This soil is naturally strong and durable. However, overflows are a menace to successful crop production. If it were feasible to build levees to protect the land from inundation it could be profitably used for the production of all staple crops.

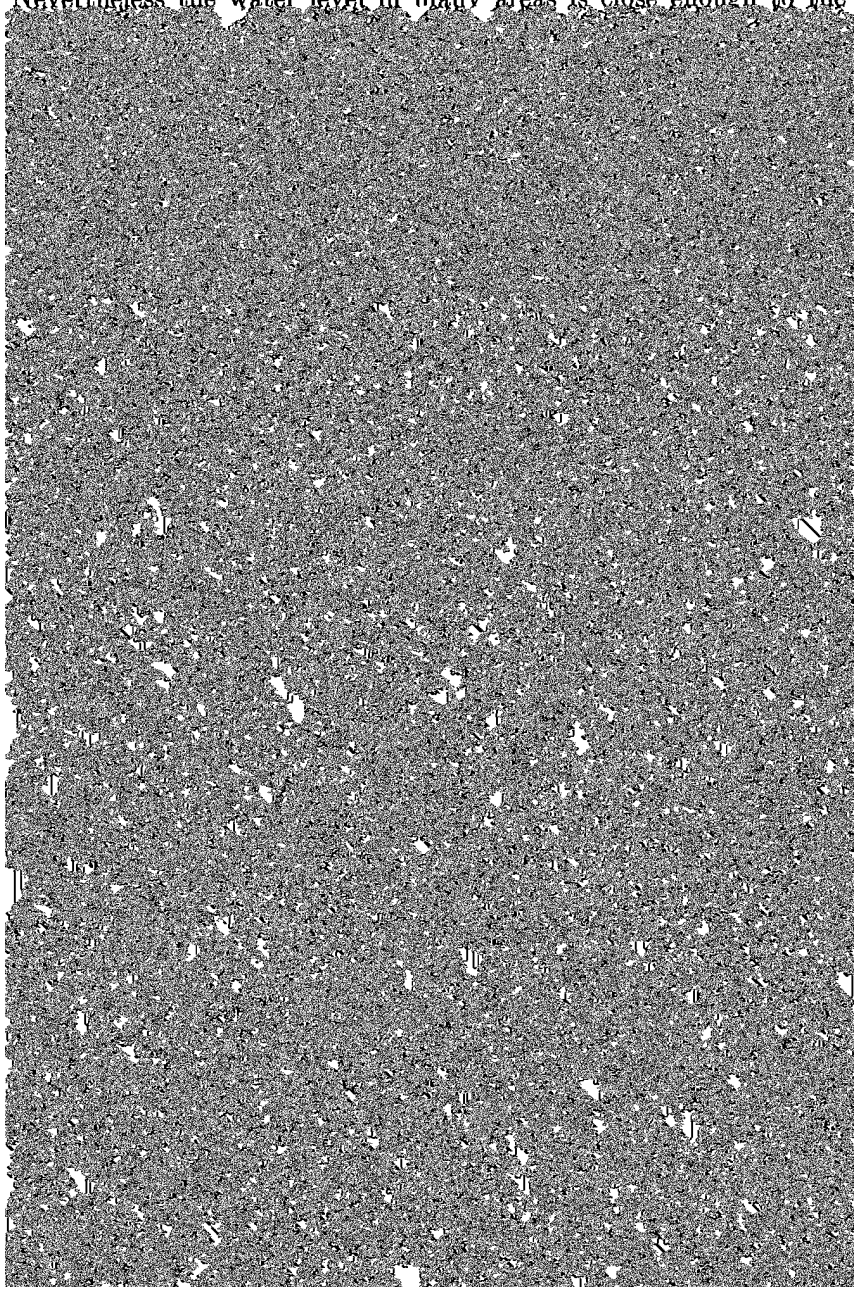
The value of this land, depending on the condition of improvements, is much the same as that of the adjoining Wabash silt loam.

GENESEE SILT LOAM

The surface soil of Genesee silt loam, to a depth varying from 10 to 14 inches, consists of grayish-yellow or light grayish-brown silt loam containing a high percentage of very fine sand. This layer grades into the subsoil, which has a predominantly pale-yellowish color and a silt loam or very fine sandy loam texture.

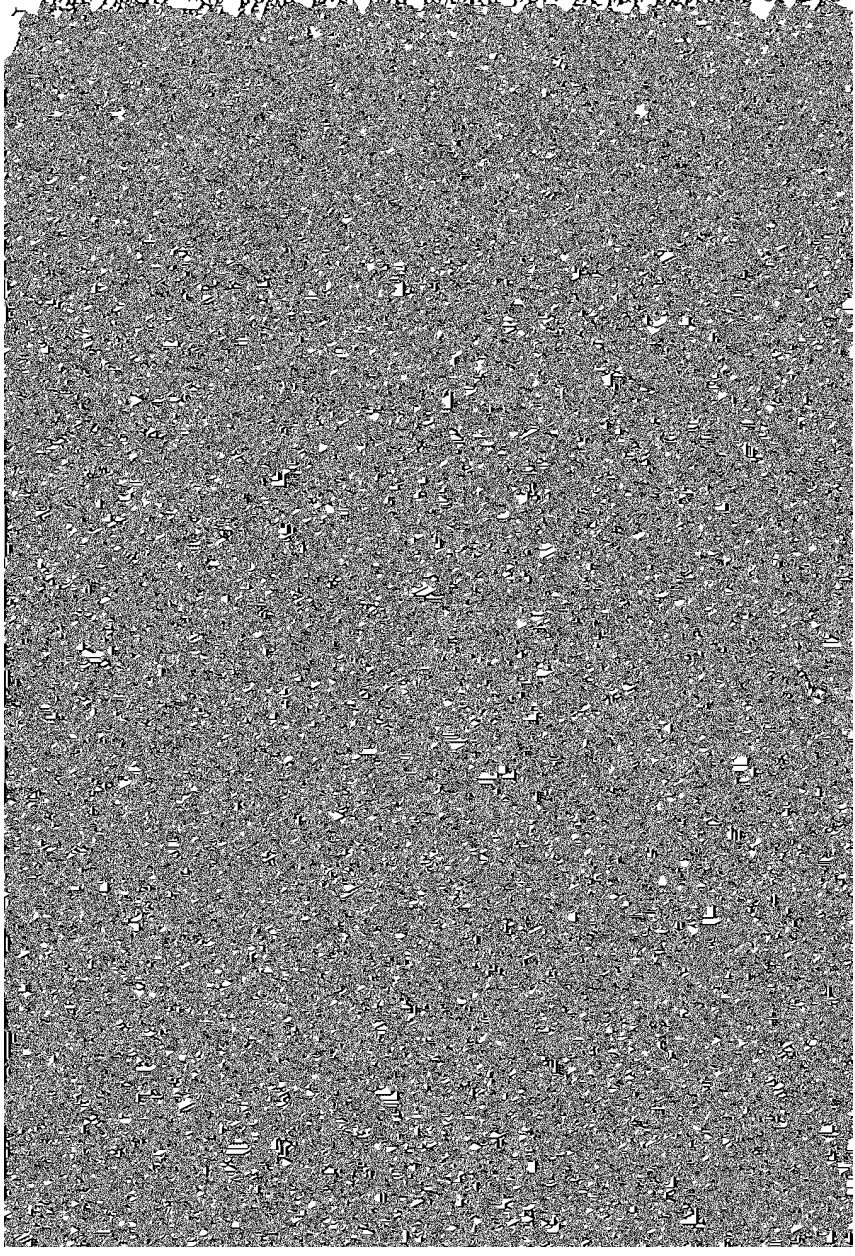
As is true in most overflow soils, a number of variations in the color and texture of the surface soils and subsoils occurs in Genesee silt loam. In section 26, T. 77 N., R. 22 W. the surface soil is gray friable silt loam, 10 or 12 inches thick, and the subsoil is composed of alternate layers of pale-yellowish silt and very fine sand. The area 1½ miles east of Ackworth has somewhat similar characteristics. Along Coal Creek, where this soil occurs in close association with Wabash silt loam, the surface soil in many places is darkened by the

Genesee silt loam is of alluvial origin and is derived from materials washed from the lighter colored uplands. The surface is level or very slightly hillocky, and the areas occupy a position 8 or 10 feet above the normal level of the rivers and 4 or 5 feet above the creeks. The downward movement of the surface waters is rapid in most places. Nevertheless the water level in many areas is close enough to the



grayish-yellow very fine sandy loam which, at a depth ranging from 28 to 32 inches, is underlain by yellowish fine sand containing varying quantities of lime. Owing to its position, slight variations in color and texture are found. The transitions to Sarpy silt loam and Sarpy fine sandy loam are gradual, and in a few places the boundaries between these soils are more or less arbitrary.

Like Sarpy silt loam this soil occurs only in the bottoms of Des



At present Sarpy fine sandy loam has little agricultural value. Truck crops of all kinds, particularly watermelons and cantaloupes, might be profitably grown. If the land were diked values would be increased, as crop yields would be more certain. Under such conditions alfalfa also could be grown to advantage.

SUMMARY

Warren County is in the south-central part of Iowa. It comprises an area of 570 square miles or 364,800 acres.

The county consists of a loess-covered drift plain. Along many of the streams erosion has exposed the underlying glacial drift. The relief ranges from level to undulating on the divides and from rolling to broken along the rivers and creeks. The elevation of the county above sea level ranges from 760 to 1,035 feet.

Warren County is drained by Des Moines River and tributary rivers and creeks. Most of the streams have cut valleys from 50 to 80 feet below the general level of the bordering uplands. Intermittent drainage ways ramify all parts of the county and afford ample drainage for most of the soils.

The population, as reported by the 1920 census, is 18,047, of which 79.9 per cent is classed as rural. The county was organized in January, 1849, and at present the entire population is made up of native-born Americans.

Transportation facilities in Warren County are good. Three great railroad systems, the Chicago, Rock Island & Pacific, Great Western, and Chicago, Burlington & Quincy, serve the county. The dirt-road system is complete. Rural mail routes and telephones serve all parts of the county, and schools and churches are conveniently located.

The climate is healthful. It is characterized by rather wide ranges in temperature. The mean annual rainfall is 32.97 inches. The average frost-free season is 166 days.

Agriculture is the principal industry, and according to the 1920 census 92.5 per cent of the total area is in farms. The value of the land is given as $167.68 an acre. Corn, oats, wheat, clover, and timothy are the principal crops. Hog raising and the raising and feeding of beef cattle are important, and dairying and sheep raising are minor industries.

The soils of Warren County have been derived mainly from glacial and loessial material. However, it is believed that the soil-forming forces such as leaching, oxidation, and the accumulation of organic matter have contributed more to the present characteristics of the soils than differences in parent materials. The soils have been separated into 26 soil types representing 15 series.

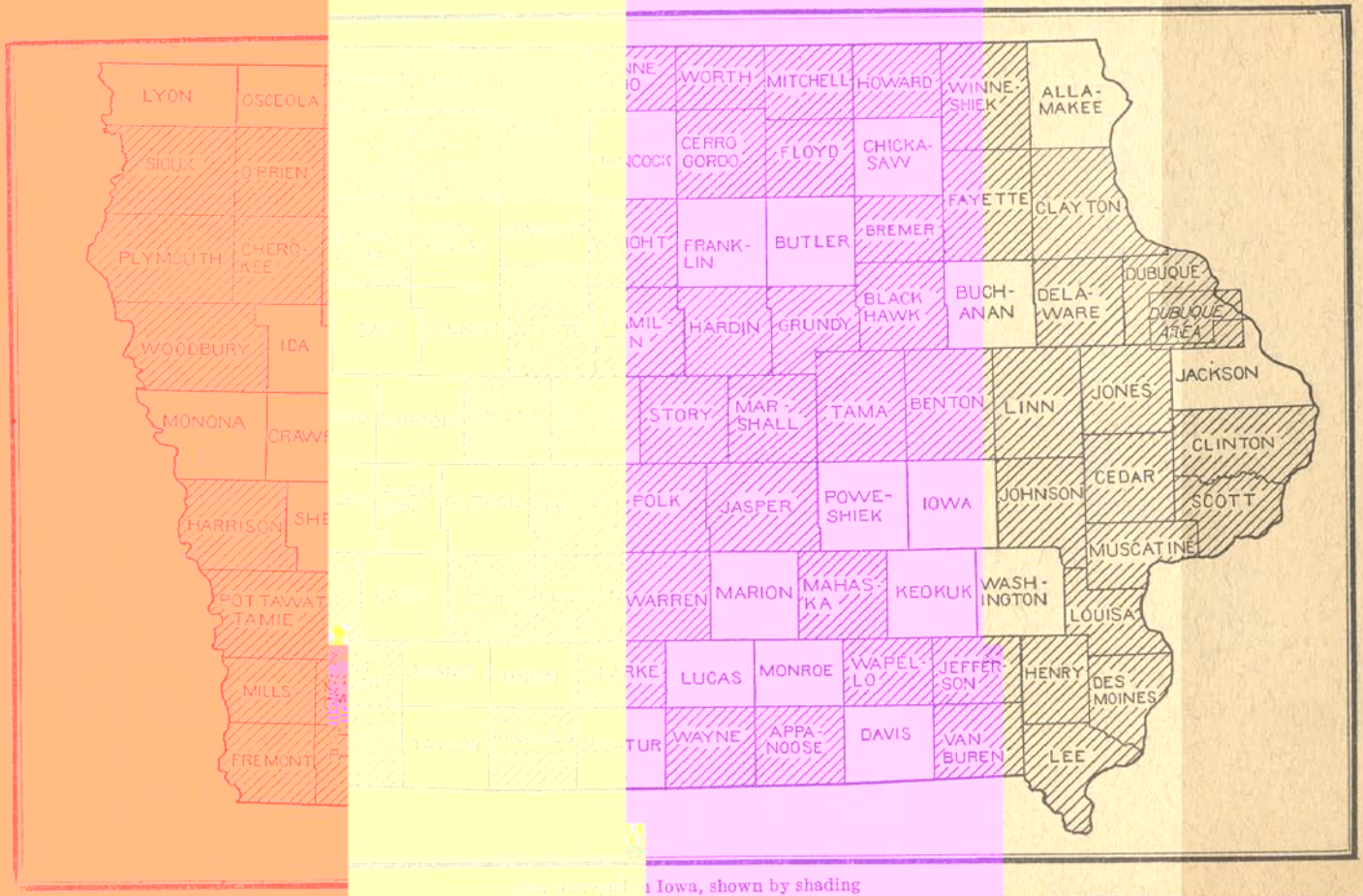
The soils may be divided, according to their most striking characteristics, into dark-colored and light-colored groups. These two groups may be subdivided into well-drained and poorly drained soils on the basis of characteristics produced by different conditions of moisture.

On the upland the dark-colored soils which have developed under good surface and subsoil drainage conditions include the soils of the Tama, Carrington, and Shelby series. The Tama soils have developed over a silty material or loess on the smooth, gently rolling upland and are among the most valuable soils in the county. The Carrington soils have developed over glacial drift on gentle slopes

and compare favorably with the Tama soils. The Shelby soils are strongly rolling or rough and only a small part of their area is farmed. The Waukesha and Judson soils of the terraces also belong to this general group of dark-colored well-drained soils. These soils are highly productive. All of the soils of this group have dark-colored surface soils and yellowish-brown subsoils.

Dark-colored soils of another group have been subjected to excessive moisture during their development. The Grundy and Muscatine soils of the flat loess-covered upland, the Bremer soils of the terraces, and the Wabash soils of the first bottoms belong to this general group. These soils have very dark grayish-brown or black surface soils and gray or mottled subsoils. Almost the entire area of the Grundy and Muscatine soils is cultivated, and the land is regarded as the most valuable in the county. The value of the other soils depends on local conditions of drainage.

The light-colored soils of the county occupy areas that were formerly covered by forests. These soils have brown, gray, or grayish-brown surface soils and yellowish-brown subsoils. The Clinton and Lindley soils of the upland belong to this group. The former are developed over loess and the latter over glacial drift. The Jackson and Calhoun soils of the terraces and the Genesee and Sarpy soils of the first bottoms are also members of this group. The light-colored soils are not so productive as the dark-colored ones. The Clinton and Lindley soils are rolling or broken, and much of their area is good only for pasture. The Jackson and Calhoun soils have a smooth surface and are fairly productive. Their greatest deficiency is in organic matter. The Genesee and Sarpy soils are developed on in vly laid river sediments and are variable in composition, drainage, ne l productiveness. Although these soils are durable, the crop yields an lower than on the more highly improved upland soils. The are nesee and Sarpy soils are all poor in organic matter and are not Ge dered so valuable as the adjoining bottom-land and terrace consi soils.



Iowa, shown by shading

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